2020 Risk Management Annual Review

Review of Risk Management Program

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TMRS
Texas Municipal Retirement System

The TMRS Investment Policy Statement (IPS) Defines What Is To Be Done And Who Is Responsible

- XIII. INVESTMENT RISK MANAGEMENT

  A. Risk Management

  TMRS will have a robust risk management program to ensure that investment risk is managed to be consistent with the risk appetite established in the IPS.

  B. Key Risks, Their Sources and Management

  1. Strategic Risk

     Strategic risk is the risk of pursuing the wrong investment strategy due to lack of clarity in investment beliefs, objectives, and/or risk tolerance

  2. Implementation Risk

     Strategy Implementation Risk is the risk that asset class portfolios and/or the total fund will underperform their strategic benchmarks or Asset Class Goals

  C. Investment Risk Reporting

- VII. ROLES AND RESPONSIBILITIES (of the Risk Management function within Investment Staff)
  - Ensuring that appropriate policies and procedures exist and are followed
  - Implementation and maintenance of analytical tools to measure and monitor risk

- **Appropriately, the IPS tells us what is required but does not specify how to achieve it**

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I. TMRS Investment Risk Management Program

Risk definition:
Risk is the uncertainty of achieving objectives

Risk Governance: Three Lines of Defense Model

Board of Trustees

- Establish investment goals and objectives consistent with plan funding needs
- Approve an asset allocation strategy (which reflects the Boards Risk Tolerance)
- Establish a written Investment Policy Statement

Executive Director

Chief Investment Officer

First Line of Defense

Risk Owners

Asset Class Directors

- Accountable for:
  - Identification
  - Measurement
  - Response
  - Monitoring
  - Communication
- Risk Guidance given by IPS Guidelines

Second Line of Defense

Risk Oversight

Risk Management Function

- Establish risk management framework
- Evaluate the effectiveness of First Line risk management (responsibility held by CIO)
- Independently monitor and report on the level of risk against established risk appetite as expressed in IPS Guidelines

Compliance

- Independently monitor and report on compliance with IPS Guidelines

Third Line of Defense

Independent Assurance

- **Internal Auditor**
  Independent assurance to Board of Trustees on effectiveness of risk management practices
- **External Auditors**
- **Investment Consultants to the Board**

Risk Governance: First Line of Defense

First Line of Defense

Risk Owners
Asset Class Directors

- Accountable for:
  - Identification
  - Measurement
  - Response
  - Monitoring
  - Communication
- Risk Guidance given by IPS Guidelines

Risk Management Process Conceptual Components

CLEAR OBJECTIVES – At every investment decision level, a clear statement or recognition of objectives being served

RISK IDENTIFICATION – Includes relevant capital markets risks, specific active strategy risks, business risks (managers and other intermediaries), internal governance and organizational risks

RISK MEASUREMENT AND EVALUATION – Includes manager due diligence, strategy risk analysis, benchmark risk analysis, risk aggregation within asset classes and the total fund

RISK RESPONSE – Includes risk ownership, manager/fund contract terms, size of investment, rebalancing

MONITORING – Includes qualitative and quantitative measures of response effectiveness, and execution and effectiveness of the process itself

COMMUNICATION – Internal risk reviews, Reporting

Risk Governance: Second Line of Defense

Second Line of Defense

Risk Oversight

Risk Management Function

- Establish risk management framework
- Evaluation of the effectiveness of First Line risk management (responsibility held by CIO)
- Independently monitor and report on the level of risk against established risk appetite as expressed in IPS Guidelines

Ensure that appropriate policies and procedures exist and are followed so that investment risk is managed consistent with the risk appetite established in the IPS

Monitor and report on risk . . .

- IPS Risk and Compliance reporting requirements

against established risk appetite as expressed in IPS Guidelines

- IPS defines allowed asset classes, allocation targets, and acceptable allocation ranges
- Expected Asset Class risk defined by a combination of historical benchmark risks (where applicable) and assumptions used in Asset Allocation Studies
- IPS Asset Class Guidelines

Risk Governance: Third Line of Defense

Third Line of Defense

Independent Assurance

- **Internal Auditor**
  Independent assurance to Board of Trustees on effectiveness of risk management practices
- **External Auditors**
- **Investment Consultants to the Board**

❖ The Investment Department and the Investment Risk Management team are not part of the Third Line of Defense

❖ The Internal Audit function provides independent assurance by virtue of not having any role in Investment Risk Management and by reporting directly to the Board

❖ The same is true for External Audit as for internal.

❖ Investment Consultants are independent from the Investment team and report directly to the Board. They are required by the Board approved IPS to "have the independence and ability to inform the Board in the event of any concerns related to investment activity"

Key Investment Risks:
Policy Setting Perspective

- Strategic Risk
  - Risk of pursuing the wrong investment strategy due to lack of clarity in:
    - Investment beliefs
    - Objectives
    - Risk tolerance
  - Managed by:
    - Asset Allocation and Pension Financial studies
    - Informed Board of Trustee Decisions

- Implementation Risk
  - Losses or unmet expectations due to:
    - Poorly designed policies and procedures
    - Policies and procedures not being followed
    - Absence of skill where skill is required
  - Managed by:
    - Documented and clearly communicated policies and procedures
    - Retention of staff with necessary skills
    - Monitoring and reporting

Managing Strategic Risk:
Three Key Policy Decisions

Major Policy Decisions	Considerations	Near term risks (less than 5 years)	Longer term risks (more than 5 years)	TMRS
Funding Methodology Determines allocation of cost burden between present and future	• Inter-generational cost fairness • Smoothing return volatility effect on funding cost	Near term costs are unnecessarily high due to being overly conservative	Future costs are unnecessarily high due to pushing cost to the future	Well considered balance between current and future costs
Asset Allocation Target Reflects desired returns and risk tolerance needed to achieve them	More aggressive allocations: • decrease cost • increase investment risk • increase "wrong and alone" risk Less aggressive do the opposite	• Return volatility • Appearance of being wrong	Future costs are unnecessarily high due to an overly conservative Target Allocation	Responsibly balances near term pension cost with: • future pension costs • near term investment risks
Actuarial Expected Return • defines todays cost of the pension promise (together with Funding Methodology) • Should reflect actual expected returns	Actuarial Expected Return different from future returns: • Underestimating shifts cost to the present • Overestimating shifts cost to the future	Near term costs are unnecessarily high due to overly conservative Actuarial Expected Return	Future costs are unnecessarily high due to overly optimistic Actuarial Expected Return	Actuarial Expected Return reflects expected future portfolio returns when active sources are included

Managing Implementation Risk

- Procedures: TMRS Investment Department Internal Procedures Manual
  - Currently over 50 procedures and 100 pages with formal responsibilities (ownership) of the overall manual and each procedure
  - Controls how investment decisions are made and executed
  - Developed to enforce consideration of all significant risks and produce documentation of having done so
  - Living document that is continually edited and updated with a framework for how those edits and updates are done
  - Due Diligence is the primary "First Line of Defense" procedure

- Necessary skills:
  - Necessary skills must exist at the level where decision-making responsibility is retained
  - CIO and Risk Management evaluate if necessary resources exist prior to proposing new investment strategies or markets

- Reporting
  - Procedure compliance reports
  - Guideline and IPS compliance reports
  - Annual Asset Class Review
  - Risk reports

Managing Implementation Risk: Due Diligence Procedure

- TMRS Due Diligence process
  - Principles based framework
  - Flexible in form but rigid in accountability
  - Designed to continually adapt
  - Process rather than outcome must be the focus of due diligence

- Part One: Due Diligence Content
  - **People:** skill and integrity to execute the strategy employed
  - **Philosophy:** attractiveness of opportunity relative to others and contribution to the portfolio
  - **Process:** evaluation of the thesis or source of outperformance and its replicability in the future
  - **Performance:** is historical performance consistent with the stated thesis, does it raise any questions
  - **Terms:** Legal fund structure, fee structure and more detailed/custom terms

- Part Two: Due Diligence Documentation – standards and verification
  - Initial Due Diligence
  - Ongoing Due Diligence (Monitoring)
  - Investment Committee review – Initial Due Diligence and Annual review of Monitoring

Managing Implementation Risk: Primary Asset Class "Building Blocks"

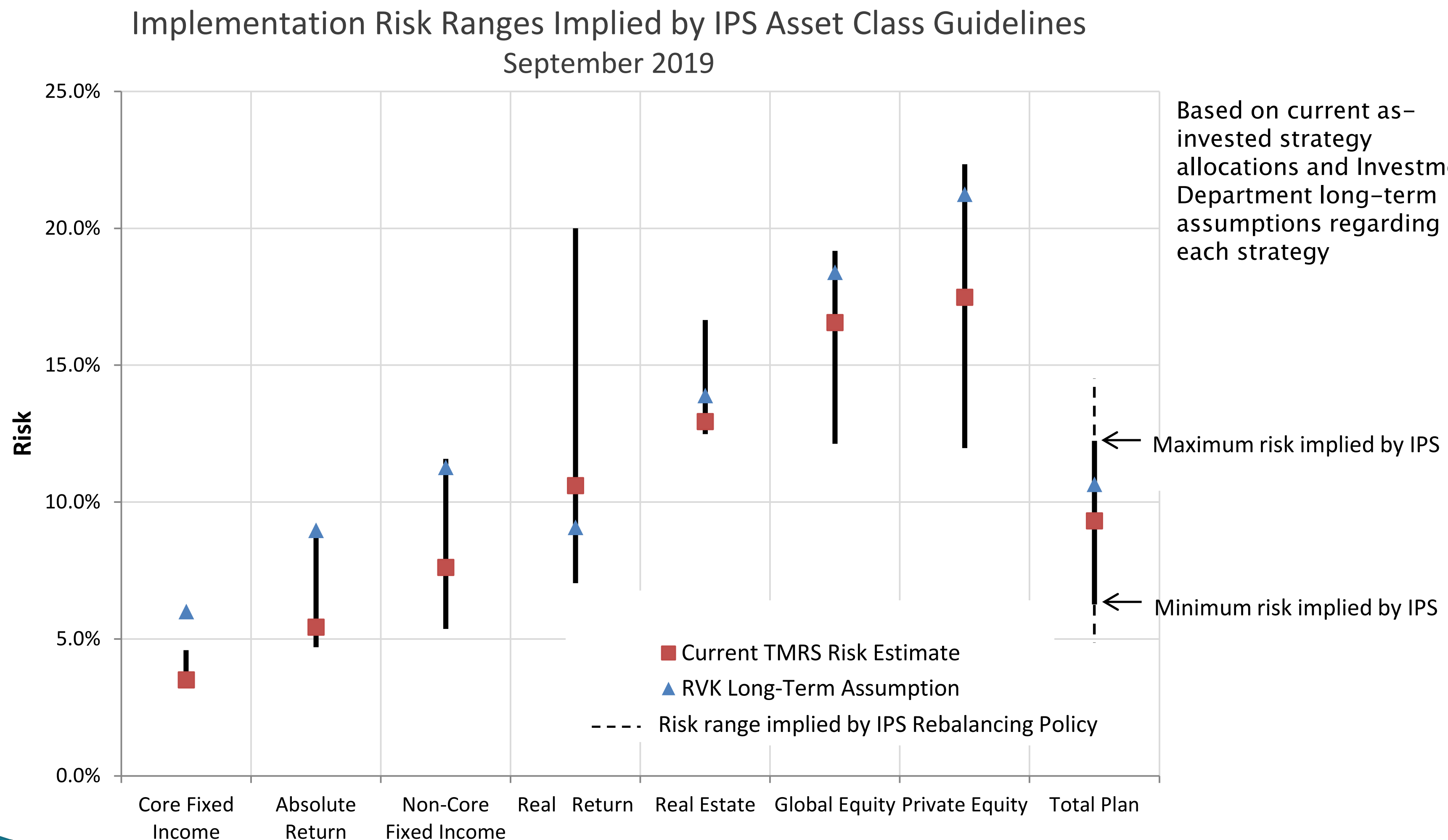
	Asset Class Building Blocks (every asset class is one of or a combination of these three building blocks)		
	Public Markets	Private Markets	Strategies to Identify and Capture Mispricing Opportunities in Public Markets
Investment Access	• Securities • Active Funds • Passive Funds	• Direct ownership • Active Funds	Active Funds (Hedge Funds)
Asset Classes	• Global (Public) Equity • Core Fixed Income • Non-Core Fixed Income • Real Assets	• Private Equity • Real Estate • Non-Core Fixed Income • Real Assets	• Absolute Return Strategies • Non-Core Fixed Income • Real Assets
Information About Investments	• Abundant • Publicly available • Cheap	• Limited • Not publicly available • Expensive	• Limited information • Limited public availability • Expensive
Liquidity	• Very liquid – large daily • Trading volume	Illiquid – trading frequency measured in years	Limited fund level liquidity
Pricing	Market pricing	Appraisal based pricing	Mostly market pricing
Portfolio Construction	Securities	Direct ownership with modest leverage	Employ all financial and investment tools to get only desired exposure
Return Sources	• Market Index (beta) • Small Active Trading component	• Active Management • Market Index (beta) • Leverage	• Active trading • Short selling • Leverage • Derivatives • Diversification
Primary Risk Source	Market Volatility	Skill and integrity of management	Skill and integrity of management

Risk Reporting:

The Quarterly Board Risk Report allows the Board to confirm that material risks taken in the investment portfolio are in line with Board intent as expressed in the Investment Policy Statement and related Studies[1]

1. Asset Allocation and Asset / Liability Studies

Risk Reporting: Implementation Risk Overview – Longer Term/Less Granular View of Allowable Risk Ranges and Current Levels



Based on current as-invested strategy allocations and Investment Department long-term assumptions regarding each strategy

The risk range implied by the IPS Rebalancing Policy includes the ability to allocate 0-10% to Cash.

Risk Reporting: Reasons for having two types of Risk Reports

		Time Horizon	
		Short	**Long**
Portfolio View	More Granular	Security Level Holdings provide an exposure and risk view that is: • Objective (better than subjective) • Meaningful	~~Security Level Holdings provide an exposure and risk view that is:~~ • ~~Objective~~ • ~~Not meaningful~~
	Less Granular	~~Asset Class Strategy[1] level exposures provide a risk view that is:~~ • ~~Subjective~~ • ~~Meaningful~~	Asset Class Strategy[1] level exposures provide a risk view that is: • Subjective • Meaningful (better than not meaningful)

1. Conceptually analogous to sub-asset class market risk premiums like: credit, rates, real estate, complexity, asymmetric knowledge, etc.)

Risk Reporting: Holdings Based Risk – Granular/Shorter Term Overview Based on Holdings

Comparing Recent Volatility to Long-Term Assumptions
Total Fund Risk by Asset Class - September 2019

	Holdings-Based Risk Model: Short-term outlook based on recent volatility of actual holdings[1]						Strategy Implementation Risk: Long-term outlook based on TMRS Staff expectations			RVK Long-term outlook
	Portfolio			Policy Benchmark						
	Weight (%)	Risk	Contribution to Total Risk	Weight (%)	Risk	Contribution to Total Risk	Minimum Risk Implied by IPS	Current Portfolio Risk	Maximum Risk Implied by IPS	Benchmark Risk
Total	**100.0%**	**6.3**	**100.0%**	**100.0%**	**6.5**	**100.0%**	**6.3**	**9.3**	**12.2**	**10.7**
Cash Assets	2.2%	0.0	0.0%	0.0%	0.0	0.0%	3.0	3.0	3.0	3.0
Global Equity	35.8%	11.3	62.0%	35.0%	11.8	62.0%	12.1	16.6	19.2	18.4
Core Fixed Income	12.9%	3.0	0.1%	10.0%	3.3	-0.2%	3.5	3.5	4.6	6.0
Non-Core Fixed Income	18.9%	4.3	10.3%	20.0%	4.1	8.8%	5.4	7.6	11.6	11.3
Real Estate	8.6%	10.3	8.9%	10.0%	10.6	9.9%	12.5	12.9	16.6	13.9
Real Return	11.3%	6.4	10.0%	10.0%	5.6	7.2%	7.0	10.6	20.0	9.1
Absolute Return	7.7%	3.4	2.8%	10.0%	3.9	0.7%	4.7	5.4	9.0	9.0
Private Equity	2.6%	19.8	6.0%	5.0%	19.5	11.6%	12.0	17.5	22.3	21.3

Portfolio risk should be similar to benchmark risk

Note which asset classes contribute more/less to risk than their weight in the portfolio (e.g. Equity)

Note risk ranges relative to assumptions used in Asset Allocation; more details on the next page

Note where current strategic positioning falls within the range, which is indicative of where we see the best risk/return trade off

1. Short-term risk numbers are based on the recent past and can be significantly different than long-term averages

Risk Reporting: Holdings Based Risk – Active Risk Due to: Allocation Decisions

September 2019

Active risk (i.e. risk of being different from the benchmark) can be divided into Allocation and Selection decisions

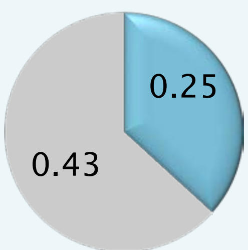
Note that a large part of our active risk is due to not yet fully implementing our Strategic Target Allocation

Note that a very small part of our risk is due to active allocation decisions to deviate from our Strategic Target Allocation

Total Active Risk = 0.68

Active Risk from Allocation

Active Risk from Selection



Asset Class	Policy Benchmark	Strategic Target Allocation (%)	Portfolio Allocation (%)	Allocation Difference (%)	Pending Policy Allocations	Active Risk from Allocation Decisions: Contribution of Pending Policy Allocation Decisions[1]	Active Risk from Allocation Decisions: Contribution of Investment Allocation Decisions[2]
Cash Assets	30 Day T- Bill	0.00%	2.20%	2.20%		0.03	-0.01
Global Equity	MSCI ACWI IMI	35.00%	35.79%	0.79%		0.00	0.00
Core Fixed Income	Barclays U.S. Agg	10.00%	12.90%	2.90%	-2.40%	0.05	0.00
Non-Core Fixed Income	50% High Yield, 50% Levered Loan	20.00%	18.94%	-1.06%		0.00	0.00
Real Estate	NCREIF ODCE	10.00%	8.57%	-1.43%		-0.01	0.03
Real Return	Manager Benchmark Rollup	10.00%	11.29%	1.29%		0.00	0.01
Absolute Return	HFRI FOF Diversified Index	10.00%	7.71%	-2.29%		-0.02	0.04
Private Equity	Custom risk proxy	5.00%	2.61%	-2.39%	2.40%	0.13	0.00
Total Active Allocation Risk		**100.00%**	**100.00%**	**0.00%**		**0.17**	**0.08**

Risk Reporting: Holdings Based Risk – Active Risk Due to: **Selection Decisions**

September 2019

For alternatives the best available benchmarks do not satisfy all of TMRS's benchmarking criteria, so active risk measurements are less precise

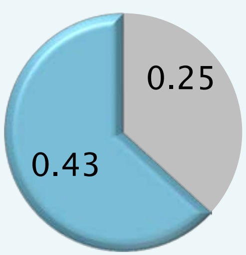
Note how much of our active risk is due to choosing manager benchmarks different from policy benchmarks

Note how much of our active risk is due to managers holding portfolios different from their benchmarks

Total Active Risk = 0.68

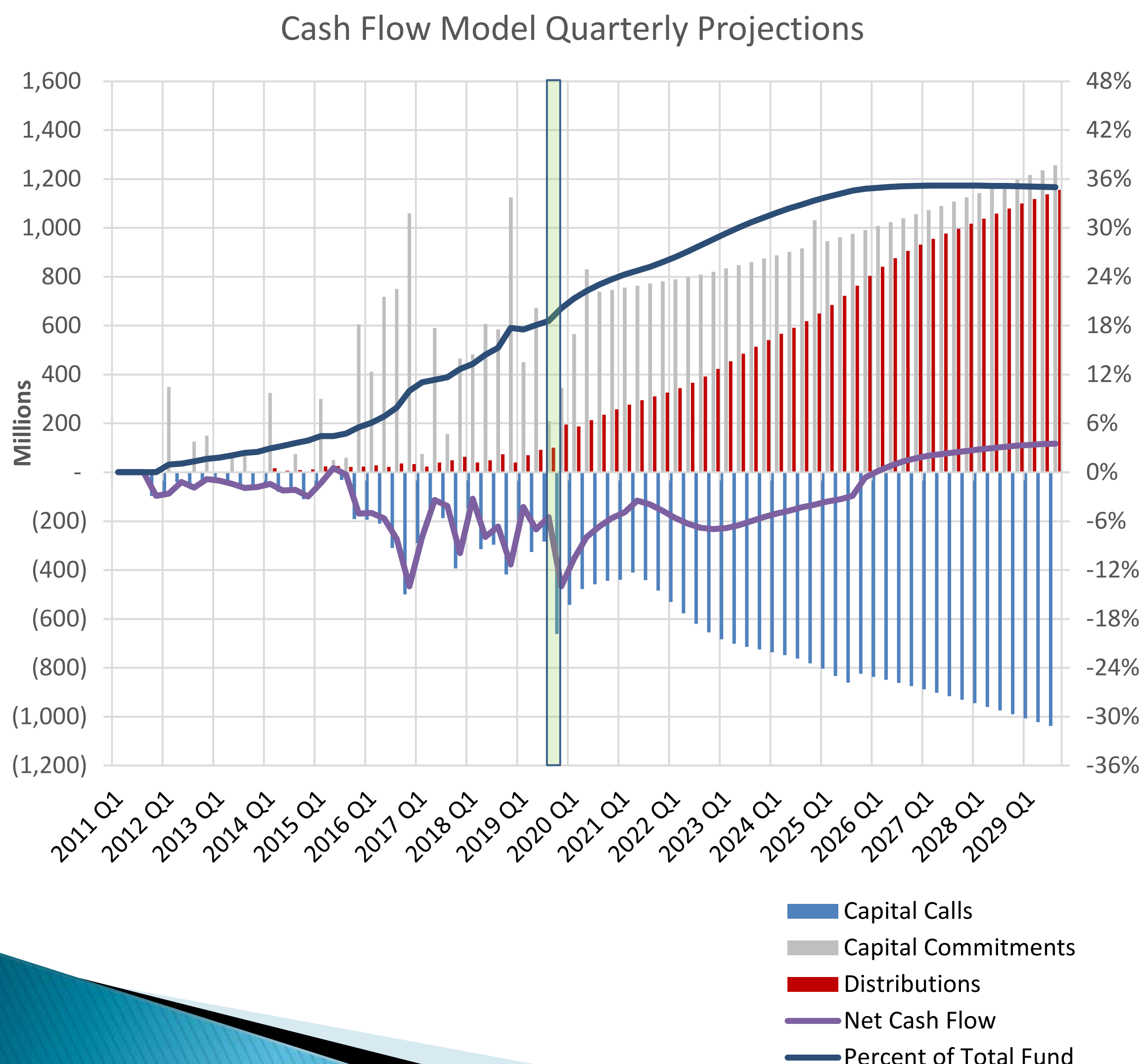
Active Risk from Allocation

Active Risk from Selection



Asset Class	Policy Benchmark	Portfolio Allocation (%)	Active Risk from Selection Decisions: Contribution of Strategy Benchmark Decisions	Active Risk from Selection Decisions: Contribution of Active Manager Decisions
Public/Traditional Investments				
Cash Assets	30 Day T- Bill	2.20%	0.00	0.00
Global Equity	MSCI ACWI IMI	35.79%	0.02	0.07
Core Fixed Income	Barclays U.S. Agg	12.90%	0.00	-0.01
Public Non-Core Fixed Income	50% High Yield, 50% Levered Loan	8.00%	0.03	0.00
Public Real Return	Manager Benchmark Rollup	4.00%	0.00	-0.01
Private/Alternative Investments				
Private Non-Core Fixed Income	50% High Yield, 50% Levered Loan	10.94%	0.00	0.01
Private Real Return	Manager Benchmark Rollup	7.05%	0.00	0.00
Real Estate	NCREIF ODCE	8.57%	0.00	0.11
Absolute Return	HFRI FOF Diversified Index	7.71%	0.00	0.17
Private Equity	Custom risk proxy	2.61%	0.00	0.05
Total Active Selection Risk		**100.00%**	**0.05**	**0.38**

Liquidity Risk Analysis:
Cash Flow Model



- Reads all private market fund capital calls and distributions
- Projects expected future fund cash flows for asset class pacing planning and total fund liquidity management
- Provides input to liquidity risk simulation model

TMRS Investment Risk Management Program: Summary

- Risk Management defines risk as uncertainty of achieving the organization's objectives
- Risk Management is a process that must be fully integrated into the making, execution, and monitoring of investment decisions
- Risk to achieving our investment objectives comes from internal and external business risks, as much as from the markets we invest in
- Absence of bad outcomes is not evidence of good risk management; a well designed, documented, and transparent risk management process is.
- TMRS has a well defined risk management process:
  - across all asset classes
  - well positioned to evolve with the growth in scope and complexity
  - strives to continuously improve the probability of meeting TMRS objectives

II. Responsibilities of the Risk Management Function at TMRS

- Risk Management Program
- Risk Analysis and Reporting

$\}$ Covered in the previous section

- Performance Reporting and Analysis
- Data Management (Investment Data Warehouse)
- Research

Performance Reporting And Analysis

- Oversight of Performance Reporting Methodologies and Procedures
  - All calculations and reconciliations are done by State Street, the Custodian Bank and Performance Calculation Agent for TMRS
  - TMRS is responsible for identifying and/or accepting the methodology used on its behalf
  - There are many industry accepted performance calculation methods and reporting practices
  - TMRS continuously strives to use the industry reporting practices most consistent with performance evaluation purposes
  - Multiple methodologies are used based on nature of investments and reporting periods

- Performance Attribution Analysis (Tool for helping to distinguish between luck and skill in the returns of active managers)
  - Historical returns of public market active managers are not predictive of future returns
  - Separate Account portfolios are the only ones where we have access to the data necessary for attribution analysis
  - Performance attribution improves our ability to evaluate skill by analyzing the return contribution from individual sector and security investment decisions

Investment Department Data Needs

- **Investment Data** – Investment decision making and risk management for a large institutional portfolio requires large amounts of high quality data that is continuously growing and evolving. (Some examples are provided in an appendix)

- **Data Usage** – Each function has its own specific set of data and reporting needs
  - Management and Administrative
  - Operational
  - Risk Management and Analytics
  - Investment Opportunity and Evaluation

- **Data Management Requirements**
  - Single (authoritative) version of every data item
  - Accurate
  - Searchable
  - Scalable
  - Robust

Investment Department Data Management Program

- **Governance and Resources**
  - Documented responsibilities and procedures
  - Systems (Oracle Database 12C, Python, Excel and PowerPoint)
  - “Platform” and Technical Support – IT Department, IT Database Administrator (DBA)
  - Architecture, development and maintenance is done by the Risk Management team

- **Current Conceptual Organization** (of Investment Data Warehouse)
  - Account Related Data (administrative and performance data)
  - Portfolio transaction and holdings data (input to risk and performance analysis systems)
  - Analytics Output Data
  - Private Funds Cash Flow simulation model
  - Dynamic Portfolio Model (Simulation of 1000’s of possible future market scenarios and the behavior of returns and cash flows of our portfolio in each of those simulations)

Research

Essential for achieving and maintaining best practice

- Only thing constant is change
  - Market behavior and opportunities
  - Industry (understanding of the markets and analytical abilities)
  - Data availability and transparency

- Risk Management conducts research to:
  - Remain current
  - Address questions that arise in the department

Examples:

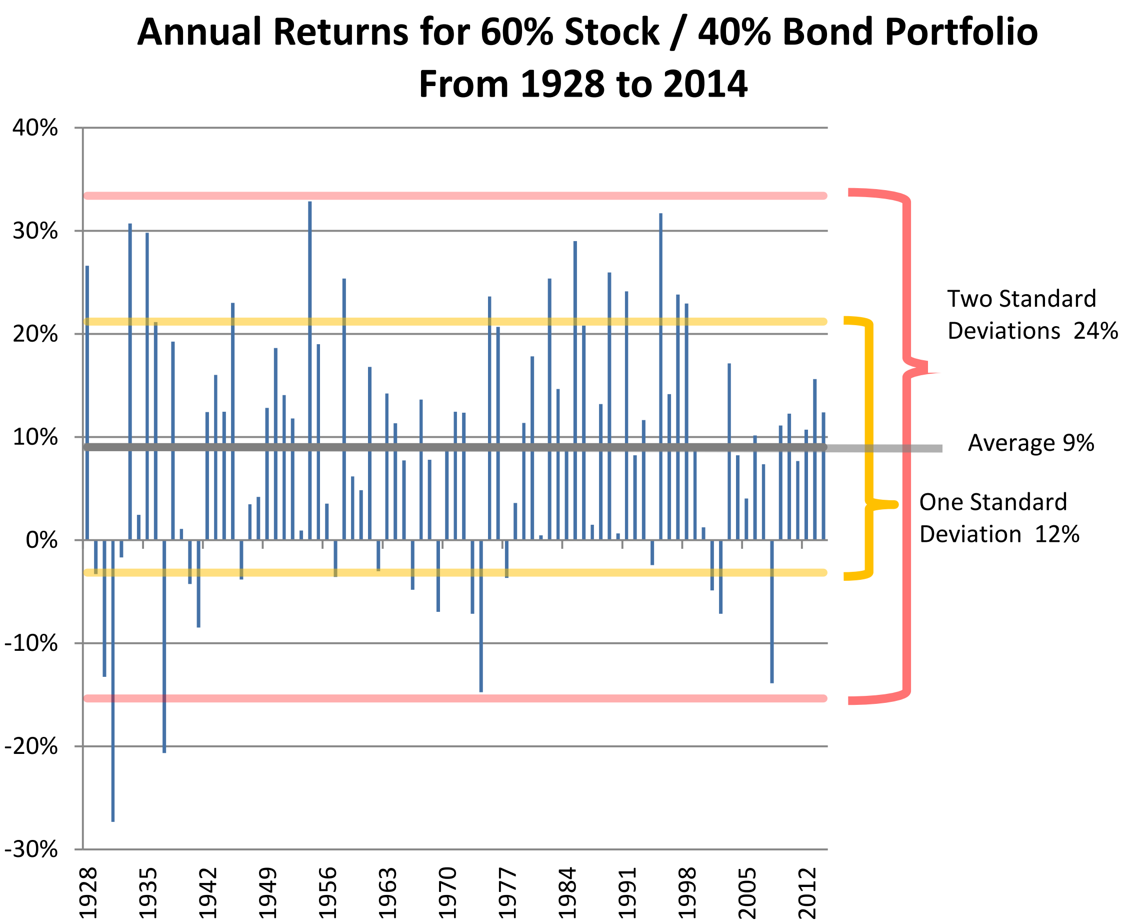
- Capital Market Behavior:
  - Term Structure of Asset Class risk (risk over longer time periods may be different from what is implied by shorter time periods)
  - Expected relative returns of developed country markets (Contrary to conventional wisdom it is not the same)

- Strategies (Total Fund):
  - Tail Risk Hedging and Volatility Capture
  - Dynamic asset allocation
  - Currency hedging/management

- Risk Measures & Analytical Methods
  - VaR (Loss <u>at</u> specified confidence level ex. 95%) and CVaR (<u>average</u> loss <u>below</u> specified confidence level)
  - Expected Maximum Draw Down
  - Liquidity risk

III. Appendices

Using History to Understand Standard Deviation

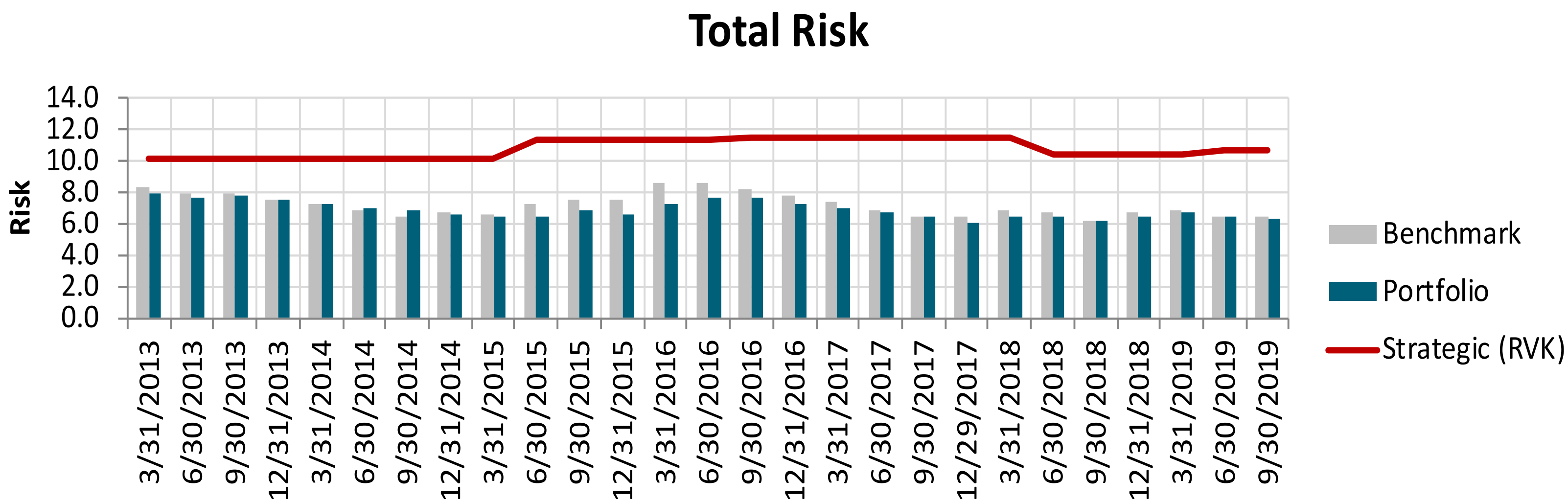


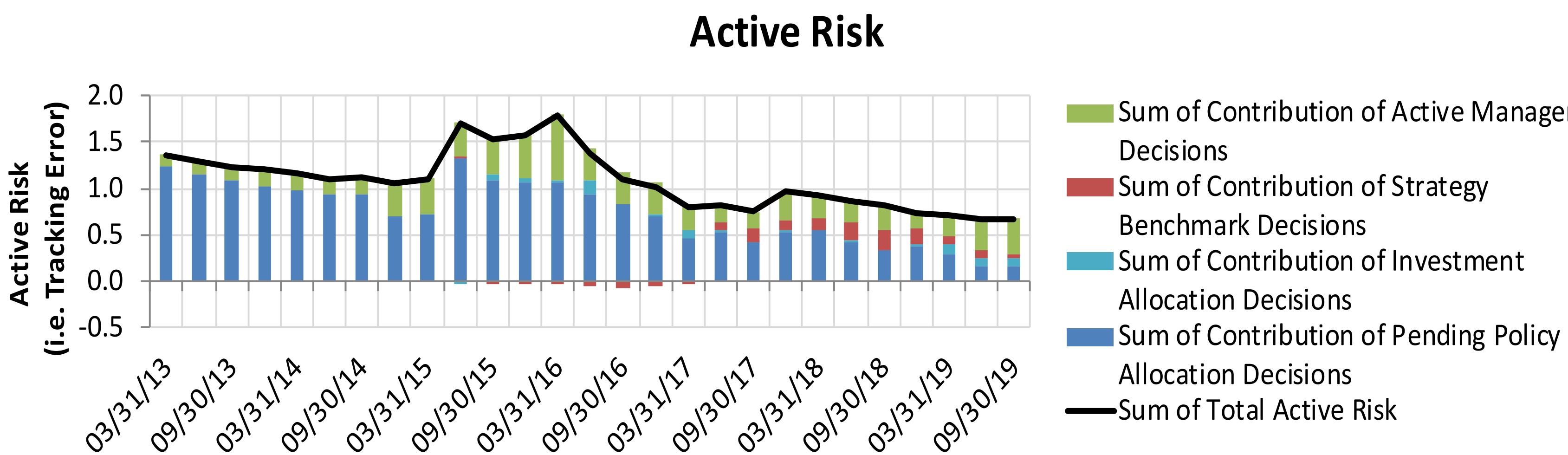
- Standard Deviation (SD) is a standardized range around the average return where:
- 16% (1 in 6 years) of the returns fall below 1 SD
- 2.5% (1 in 40 years) of the returns fall below 2 SD

Evolution of Risk Over Time

September 2019

Appendix 2



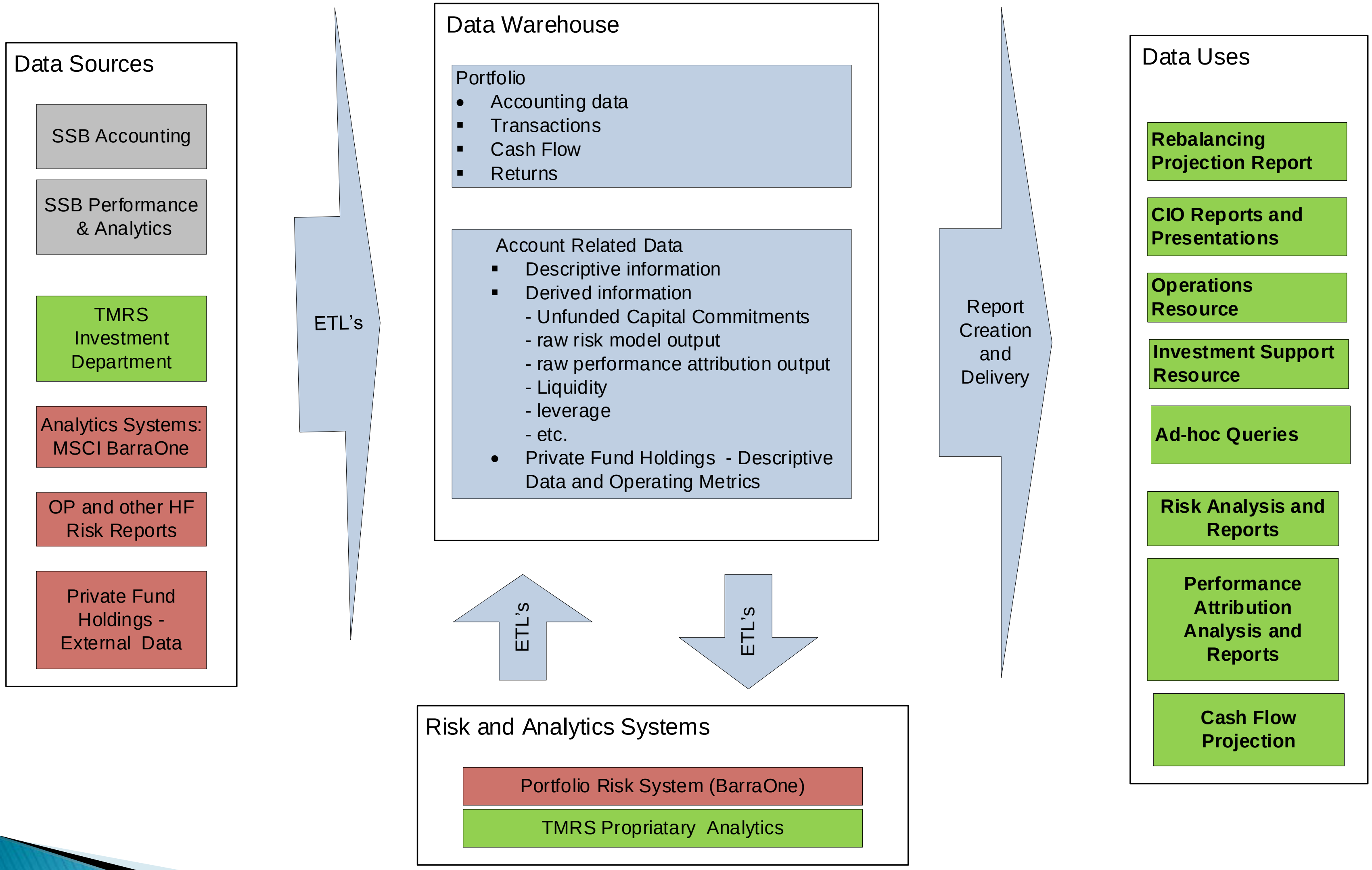


Examples of type and volume of data used by TMRS Investment Department

- Over 200 investment accounts
  - Over 50 administrative data items per account
  - Full accounting, transaction and performance history for each account
  - Over 4,000 securities in 23 Separately Managed Accounts
- Over 63 countries and 33 currencies
- 7 asset classes and more than 30 sub-asset classes
- Dozens of market sector and industry classifications and multiple classification systems
- Over 1,400 raw risk system reports used in production of Board and internal Risk Reports
- Over 200 raw performance attribution system reports used in performance attribution analysis

Appendix 4

TMRS Investment Data Warehouse Conceptual Schematic



ETL stands for "Extract, Transform, and Load"