

LIQUIDITY STRESS TESTING TOOLKIT

A key steering tool for liquidity measurement and management

AGENDA

1. Toolkit
2. Process overview
3. Areas of focus
4. Integration

LIQUIDITY STRESS TESTING TOOLKIT

Leveraging on its experience and in line with market practices, Avantage Reply has developed a Liquidity Stress Testing model.

Flexible and easy to use, it provides financial institutions with a toolkit which allows them to easily perform internal stress tests and integrate outcomes into decision-making processes.

Appropriate liquidity stress test modeling is a prerequisite for simulating and understanding the liquidity position and to assess liquidity adequacy.

The LST toolkit has many features, as summarised on the right:



Multi-scenarios

Allows calibration of up to 5 scenarios



2 Propagation speeds

Gradual vs fast Scenario



Sensitivity analysis

Ability to understand the sensitivity of key material risk factors



2 Parallel simulations

Allows the ability to stress two different data sets in parallel



2 Approaches

Normative and Economic



3 Metrics

LCR : Liquidity Coverage Ratio
NSFR : Net Stable Funding Ratio
NLP : Net Liquidity Position

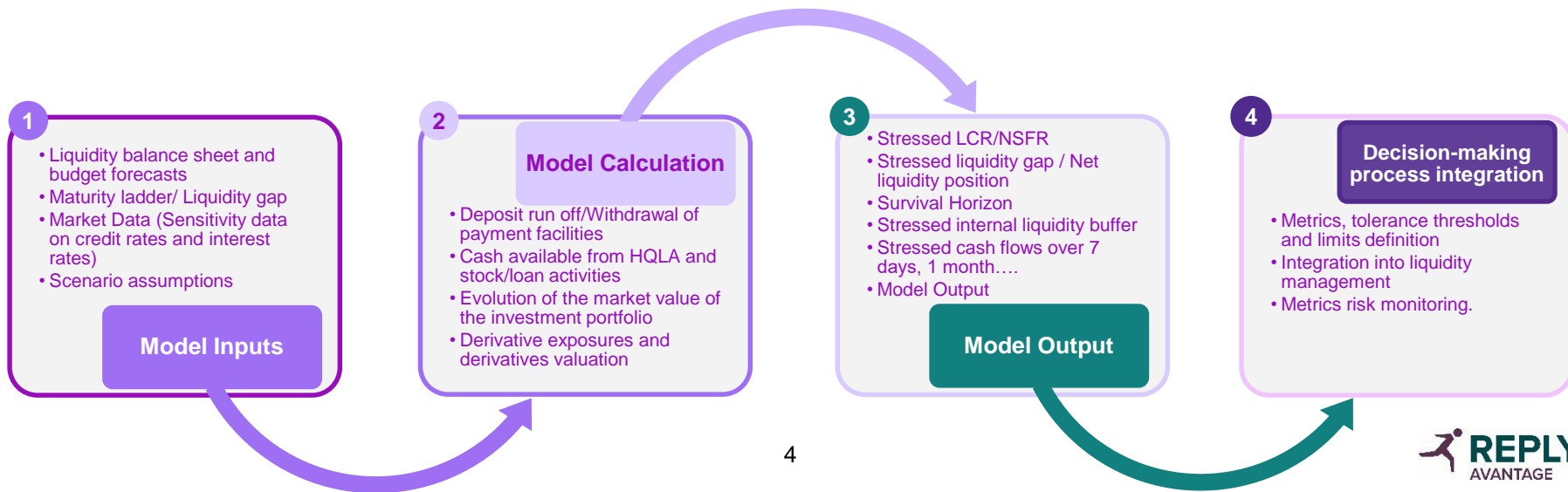
LIQUIDITY STRESS TESTING TOOLKIT

Process Overview

Appropriate liquidity modeling is a prerequisite for simulating and interpreting the impact of different scenarios on an institution's liquidity adequacy (e.g. minimum requirement of HQLA assets, stressed LCR/NSFR, stressed NLP, survival horizon).

The liquidity stress test model has the following features:

- Relies on regulatory, ALM and budget forecasts data;
- Shows the impact on the internal and regulatory metrics **through different types of scenarios and propagation speeds;**
- Is flexible and able to be reused and **integrated into liquidity management and risk monitoring;**
- Is **built in VBA/Excel**, but could eventually be replaced by a more robust long-term solution.



LIQUIDITY STRESS TESTING TOOLKIT

Area of focus - Risk factor mapping & Risk factor analysis

Step 1	Model inputs
Step 2	Model calculation
Step 3	Model outputs
Step 4	Decision-making process integration

The liquidity stress test model is implemented on defined stress scenarios aiming to transform contractual or behavioural assumptions to balance sheet cash-flows.

Shocks reflected on risk drivers are applied by product type (deposits, loans, etc.) and per time bucket on key internal and regulatory metrics.

The risk driver mapping is a key preliminary step within the LST process. It consists of identifying the key liquidity risk drivers to which the institution is exposed and that could impact the liquidity balance sheet.

The main objective is to identify key liquidity vulnerabilities before conducting the risk driver analysis.

The analysis of risk drivers can be carried out by an empirical analysis and in particular by sensitivity analysis that aims to describe how fast the NLP goes negative based on the individual sensitivity of each risk driver. It should allow the impact of key material risk factors to be assessed in order to identify the areas of focus that should be considered in the scenario design and calibration stage.

Risk Driver Specification (ILAAP based)

Risk driver - level 1	Risk driver - level 2
Cash	Cash and cash balances with CB
Franchise viability - CB	Reverse Repo - cash inflow
Franchise viability - Non Professionals	Restriction of retail lending
	Restriction of wholesale lending - Corp
Franchise viability - Professionals	Restriction of wholesale lending - Professionals
Liquidity of marketable assets	Insufficient level of Liquid Asset Buffer
Securities & repo	Securities Borrowing - Collateral Outflow
	Securities Lending - Collateral Inflow
	Repo - collateral inflow
Off BS item	Reverse Repo - collateral outflow
	Draw down - Non Professionals
Retail Funding	Draw down - Professionals
	Guarantees
	Sights Deposits outflow
Wholesale funding - CB	Term Deposits outflow
	Repo - cash outflow
	ST unsecured WHS funding not rolled over - CB

LST Risk Factor level 1	LST Risk Factor level 2	LST Risk Factor level 3	Risk driver per risk driver	Stressed NLP view per risk Factor																				
				100%	95%	90%	85%	80%	75%	70%	65%	60%	55%	50%	45%	40%	35%	30%	25%	20%	15%	10%	5%	
Who	INFLWS	Lending	Financial Customers	137 323 983.00	245	238	231	224	217	211	204	197	190	183	176	169	162	156	149	142	135	128	121	114
	INFLWS	Lending	Retail	930 595 753.00	245	198	152	105	59	12	-34	-81	-127	-174	-220	-267	-313	-360	-407	-453	-500	-546	-593	-639
	INFLWS	Lending		80 713 915.29	245	242	239	236	233	230	227	224	221	218	215	211	208	205	202	199	196	193	190	187
	INFLWS	Maturing securities		186 158 800.00	245	238	230	217	208	198	189	180	170	161	152	142	133	124	115	105	96	87	77	68
	LIQUID ASSETS	Cash		1 145 775 953.31	245	188	130	73	16	-42	-99	-156	-213	-271	-328	-386	-443	-500	-557	-614	-672	-730	-788	-844
	LIQUID ASSETS	Level 1 tradable assets		189 158 800.00	245	238	230	217	208	198	189	180	170	161	152	142	133	124	115	105	96	87	77	68
	OFF-BALANCE	Committed credit facilities		-71 452 940.38	245	248	252	256	259	263	266	270	273	277	281	284	288	291	295	298	302	306	309	313
	OUTFLOWS	non-operational deposits	Financial Customers	-10 411 053.94	245	245	248	246	247	247	248	249	249	250	250	251	251	252	252	253	253	254	254	255
	OUTFLOWS	non-operational deposits	Non-Financial Customers	-120 741 120.12	245	251	257	264	270	276	283	289	295	301	308	314	320	327	333	339	345	352	358	364
	OUTFLOWS	Operational Deposits		-33 823 052.39	245	247	248	250	252	253	255	257	258	260	262	263	265	267	269	270	272	274	275	277
	OUTFLOWS	Retail non stable deposits		-768 497 263.06	245	283	321	380	368	436	475	513	551	590	628	666	704	742	781	819	857	896	934	972
	OUTFLOWS	Retail stable deposits		-1 384 938 805.05	245	315	394	454	524	594	663	733	803	873	942	1 012	1 082	1 152	1 221	1 291	1 361	1 431	1 500	1 570

LIQUIDITY STRESS TESTING TOOLKIT

Area of focus - Stress scenario definition and calibration

Step 1	Model inputs
Step 2	Model calculation
Step 3	Model outputs
Step 4	Decision-making process integration

Liquidity stress testing objectives are to evaluate whether institutions maintain adequate liquidity under stressed scenarios and to provide information at a time of liquidity crisis to allow management to act in a timely manner. Ideally, **scenarios should be framed as follows:**

- Narratives to scenarios:** The set of scenarios provide information that allows the evaluation of a wide range of events that can be either directly linked to the institution, to the market,....
- Scenario types :**
 - Scenarios that evaluate **idiosyncratic stress features;**
 - Scenarios that evaluate **market wide stress features;**
 - Scenarios that evaluate **a combination of idiosyncratic stress and market wide stress features;**
 - Scenarios that **evaluate reputational stress features;**
 - Pre-determined scenarios that the **institution wants to survive for a pre-determined amount of time;**
 - Reverse stress features.**

- Fast versus gradually developing stress:** Such distinction is especially relevant to understand and **evaluate the impact of the relevant management actions within each scenario.** For example, a rapidly developing stress event would not benefit from actions which take a longer time to initiate or that require relatively low levels of stress to initiate.

Stress scenarios vs Risk driver	Key risk factors family						
	Deposit rollovers	Professional funding rollovers	Drawing on off B/S facilities	Investment portfolio haircuts	Collateral outflows	Rating downgrade impact	Other in/outflows
Scenario 1	✓	✓	✓	✓	✓	✓	✓
Scenario 2	✓	✓	✓	✓	✓	✓	✓
...	✓	✓	✓	✓	✓	✓	✓

Liquidity risk driver
 Risk drivers should be stressed over the horizon period of the stress tests

- Deposit rollovers
- Professional funding rollover
- Drawings on off B/S facilities
- Investment portfolio haircuts
- Collateral outflows
- Rating downgrade impact
- Other in / outflows
- Additional assumptions

LST Risk Driver level 1	LST Risk Driver level 2	LST Risk Driver level 3	Idiosyncratic	Marketwide	Combined (B0+M0)
LIQUID ASSETS	Cash		100 %	100 %	100 %
	Level 1 tradable assets		99.5 %	96.1 %	97.8 %
INFLOWS	Lending	Financial Customers	100 %	100 %	100 %
	Lending	Retail	50 %	50 %	50 %
	Lending		100 %	100 %	100 %
OFF-BALANCE	Maturing securities		100 %	100 %	100 %
	Committed credit facilities		3 %	6 %	9 %
	Retail non-Stable Deposits		50 %	20 %	50 %
OUTFLOWS	Retail Stable Deposits		25 %	5 %	25 %
	Operational deposits - not covered by DGS	Financial Customers	100 %	25 %	100 %
	Non-operational deposits - Other	Financial Customers	100 %	100 %	100 %
	Non-operational deposits - covered by DGS	non-Financial Customers	100 %	100 %	100 %
	Non-operational deposits - not covered by DGS	non-Financial Customers	100 %	100 %	100 %
				100 %	100 %

- Illustration -

The weights corresponds to the percentage of inflows

The weights corresponds to percentage of outflows. (1-weights) corresponds to the amount remaining

Risk driver calibration

Each risk driver is mapped to a component of the metric to be stressed and calibrated upon internal or empirical analysis, real events or benchmarks.

Propagation speed

The shock level presented in this table represents a maximum level achieved in a linear way depending the propagation speed of the scenario.

LIQUIDITY STRESS TESTING TOOLKIT

Area of focus - Calculation Process

Step 1	Model inputs
Step 2	Model calculation
Step 3	Model outputs
Step 4	Decision-making process integration

Risk drivers :



- Deposit or wholesale funding rollovers;
- Drawings on off B/S facilities;
- Investment portfolio haircuts;
-



Scenarios:



- Narratives to scenarios:
- Scenario types :
- Fast versus gradually developing stress:



Calculation:

1. The shocks defined by risk driver are **applied to each component of the internal or regulatory metrics.**
2. Stressed metrics are then calculated as below :

Internal Metrics

- The stress testing methodology determines **two output metrics:**
 - 1) **NET LIQUIDITY POSITION (NLP)**
 - 2) **TIME-TO-SURVIVE (TTS)**
- The **NLP** is calculated **using the Liquid Assets and the inflows and outflows** resulting from the stress test scenario, which is **then broken down into pre-determined time buckets** (1day, 2 days....etc):

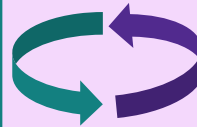
$$NLP = \text{Liquid Assets} + \text{Inflows} - \text{Outflows} - \text{Off-balance} +/- \text{Secured Transactions}$$

- The **TTS** is determined using the NLP. The bank is **assumed to survive as long as the NLP is positive**. The TTS is calculated as the last period before the NLP becomes negative.

In practice, the **NLP** calculation is built like a **cumulated static gap**.

NB: Other bank-specific metrics could be integrated.

Stressed NLP and Survival horizon under various scenarios and propagation speed...



Regulatory Metrics

- **Projected LCR**
 - The stress testing methodology is based on the projection of 30 days cash flows for 3 years broken by month.
- **Projected NSFR :**
 - The stress testing methodology is based on the budget projection for 3 years broken by month.

$$LCR = \frac{\text{Liquid Assets}}{\text{Net Cash Flows (30Days)}}$$

$$NSFR = \frac{\text{Available Stable Funding (ASF)}}{\text{Required Stable Funding (RSF)}}$$

Stressed LCR/NSFR under various scenarios and propagation speed...

LIQUIDITY STRESS TESTING TOOLKIT

Area of focus - Analysis and management actions

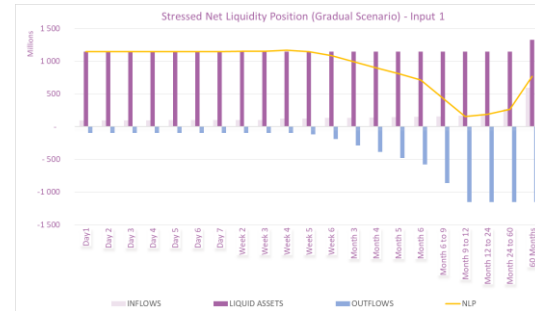
- Step 1 Model inputs
- Step 2 Model calculation
- Step 3 Model outputs**
- Step 4 Decision-making process integration

Once scenarios have been defined and shocks calibrated by risk driver, the liquidity stress testing tool allows an institution to directly view the **impacts with flexibility** to vary the **scenario to be applied**, the **speed of propagation** or even the **input data on the LCR, NSFR and NLP**.

The **3 indicators can be analysed separately** but the strength of the toolkit is to allow **cross analysis to determine the right management actions** to apply. As the tool allows two data sets to be run in parallel, results can be generated both with and without management actions taken into consideration.

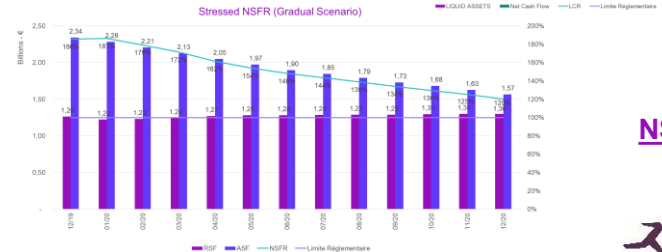
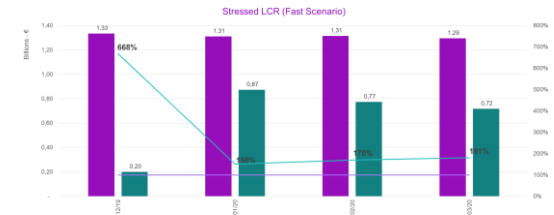
Note that **Net Liquidity Position and Time-to-survive are complementary indicators** of the LCR and NSFR. In fact, it could **reveal some bank's vulnerabilities** that the LCR and NSFR can't highlight due to their definition/calculation.

One of the useful outcomes of the stress tests could be to ensure a **better link between management and risk monitoring**. The results could be used to **set early warning indicators and limits**.



Net Liquidity Position and Time-to-survive

LCR



NSFR



LIQUIDITY STRESS TESTING TOOLKIT

Integration into liquidity management or measurement

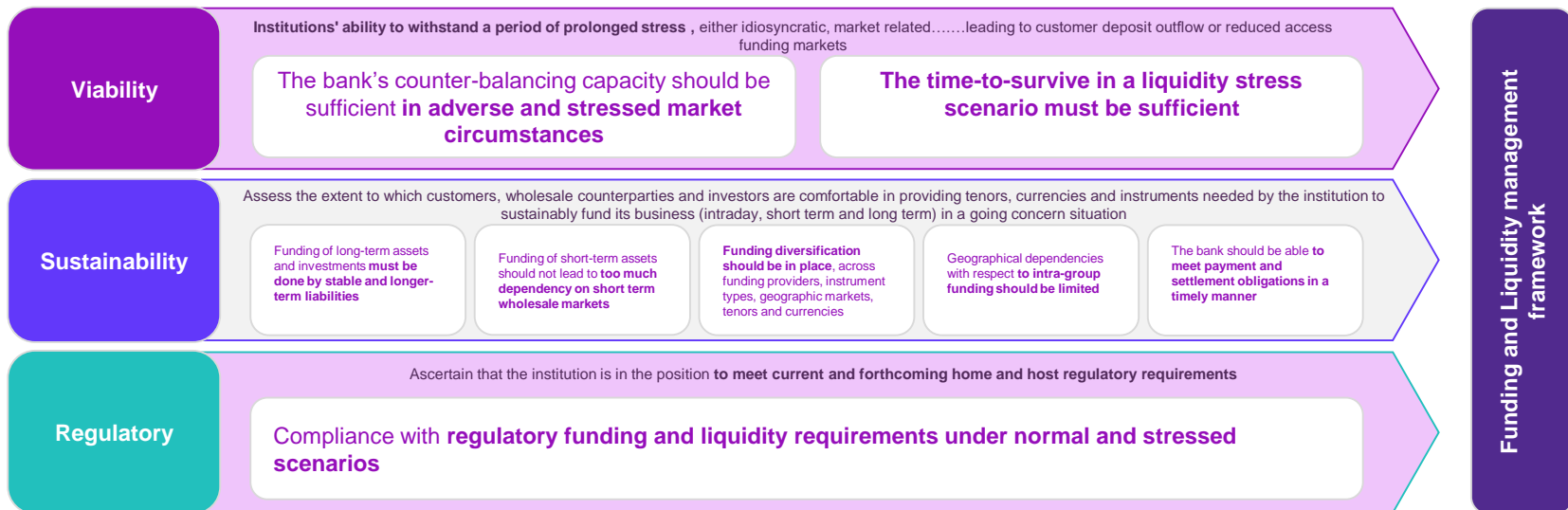
Step 1	Model inputs
Step 2	Model calculation
Step 3	Model output
Step 4	Decision-making process integration

The Funding & Liquidity management framework could be defined **through 3 lenses**:

- 1. Viability
- 2. Sustainability
- 3. Regulatory

To ensure a proper integration of Liquidity stress tests, **the institution's viability and regulatory indicators should be stressed under different scenario and propagation speeds.**

Funding and Liquidity adequacy



AVANTAGE REPLY FRANCE

Our service offering

Expert and methodological support in ALM, Finance and Risk around strategic risk management and management processes, governance of Finance and Risk functions, risk modeling and scarce resources (capital, liquidity) and stress tests



Finance Risk

- Our teams support CROs and CFOs from the design of target systems to operational implementation at Group or entity level.
- Our missions last from 1 month to 1 year. On average, they last 6 months.

	Strategy and governance	Steering	Modeling	Regulatory (transversal offer)
Finance	Business model assessment	ICAAP	P&L Modeling and Stress tests	<ul style="list-style-type: none"> • Regulatory watch • Regulatory strategy • Remediation • Project management
	Capital management governance	Capital allocation policy	Business / Capital modeling	
	Solvency stress testing governance	TLAC/MREL	Resolution modeling	
Risk	Risk governance	Material risk assessment	Pillar 1 Risk models design and validation	
	Model risk management	Risk appetite	Model risk tiering and scoring	
	Regulatory strategy	Recovery plan	Pillar 2 models and risk stress tests	
ALM	ALM governance	ILAAP	ALM risk metrics	
	ALM strategy (including hedging)	IRRBB	ALM models	
	Fund transfer pricing	Contingency plan	Liquidity stress tests	
Trading Activities	Desk strategy	P&L attribution	Pricing models	
	Desk hedging strategy	Market risk policy	Valuation/PVA	
	Model risk management	Limit framework	Risk models/Stress tests	
				SREP/TRIM
				BRRD
				CRR/CRD 4
				CRR2/CRD 5
				Guidelines EBA/BCE...



Strategic diagnosis, gap analysis and benchmarking



Definition and design of steering processes and dashboard



Organizational and governance redesign



Deployment and operational implementation



Modeling and Quantitative studies



Subject matter expert support

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