IBM

Insight2014

The Conference for Big Data and Analytics

So - You've got Big Data? Now find out how to take care of it

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February 10, 2015

SEIZE THIS MOMENT

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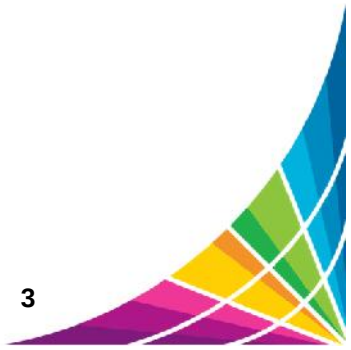
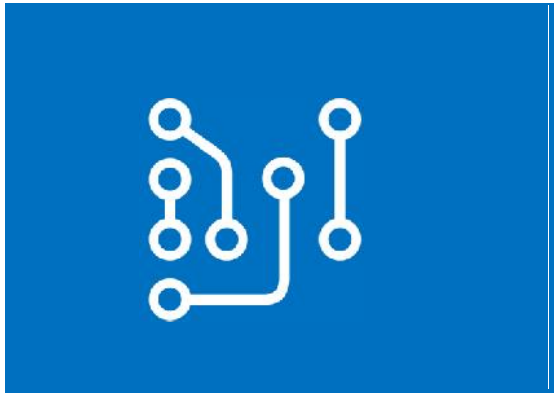
Agenda

- How to analyze Big Data for IMS
- How to manage Big Data for IMS
- How to diagnose issues with Big Data for IMS
- Q&A



There are three important shifts fundamentally changing the way that decisions are made…

Data

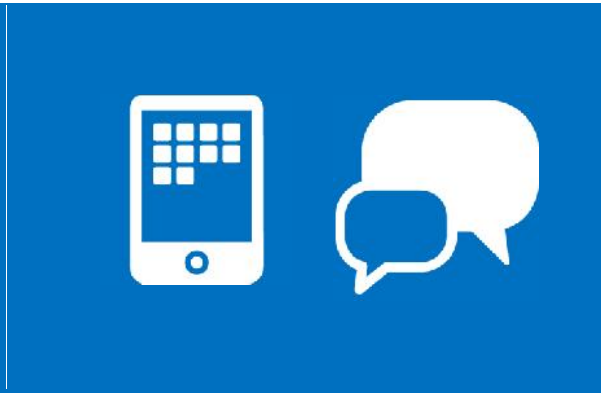


Data is becoming the world's new natural resource

Cloud

The emergence of cloud is transforming IT and business processes into digital services

Engagement

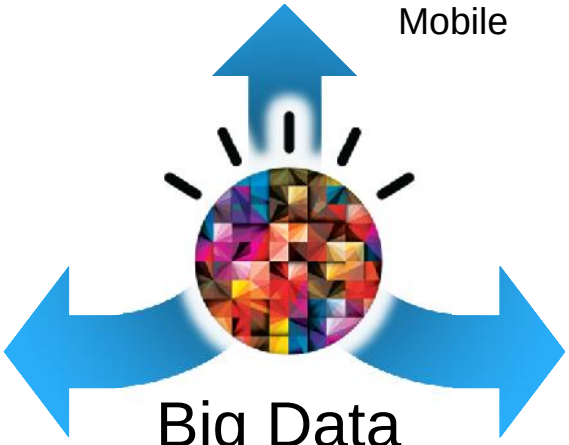


Social. Mobile. Security. Empowering people with knowledge, enriching them through networks and changing expectations.

Business and industries are being transformed by these shifts

Mobile

Systems of Record



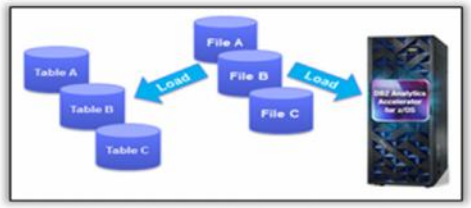
Big Data
&
Analytics

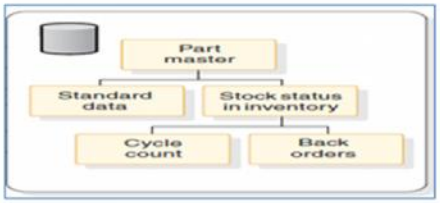
Systems of Engagement

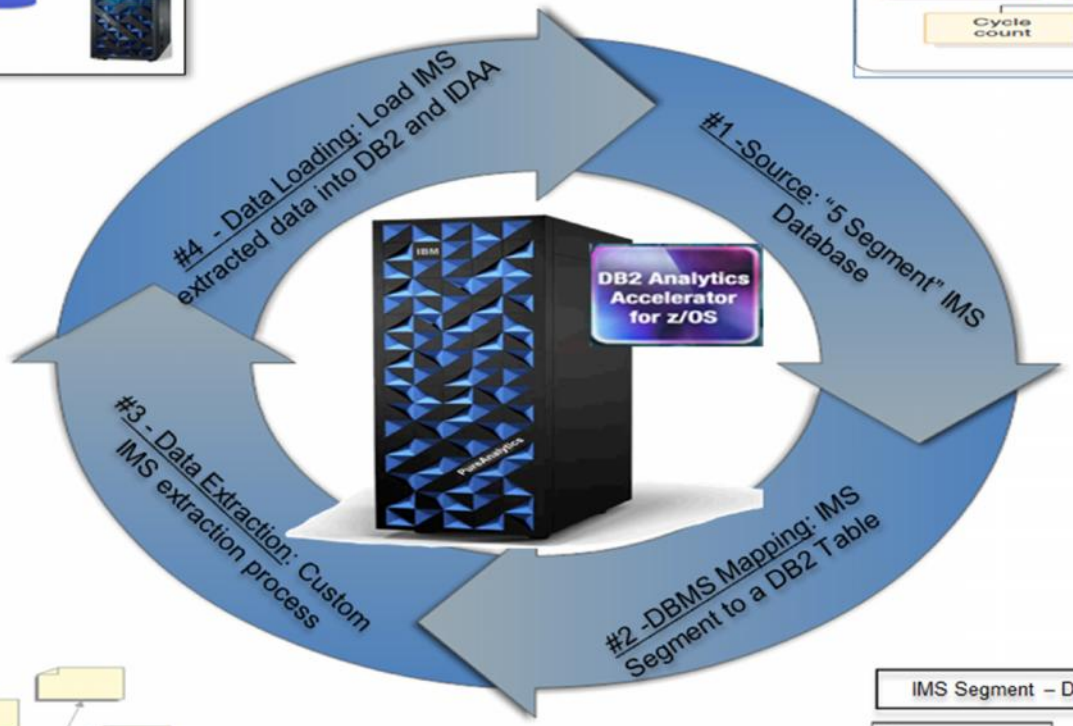
Cloud

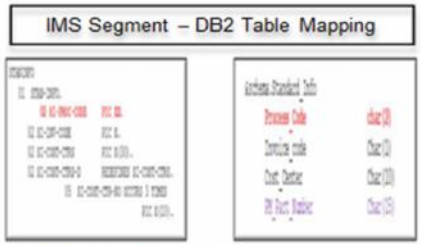
Analysis with Big Data for IMS

IMS to DB2 Analytics Accelerator:
External Load Process – Use Case



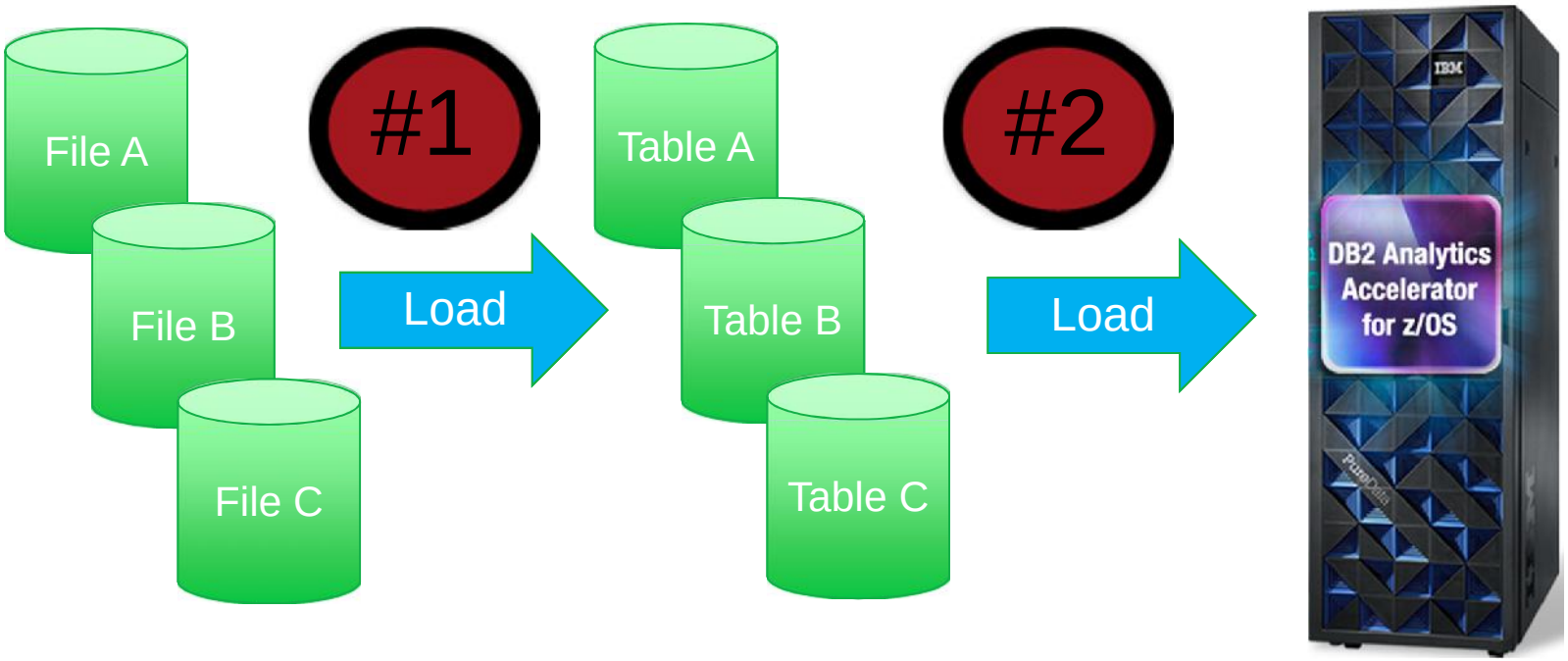






Building Data Warehouse on DB2 z/OS

External Data | DB2 Tables | DB2 Analytics Accelerator

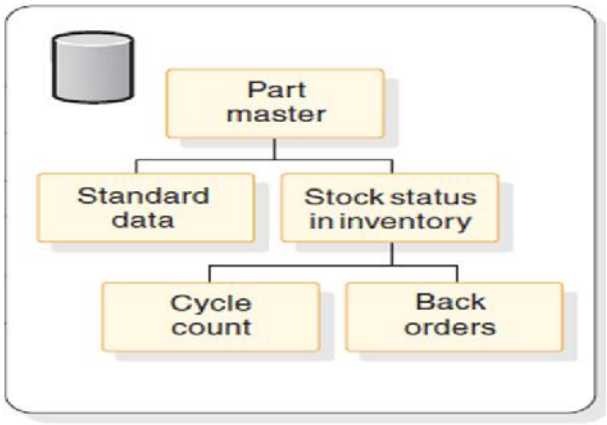


Two Step Load Process – Elongated Load Cycle - CPU Resource Intensive

Mapping and Transforming Data

- Segment -> Table
  - Field -> Column
- Data type not required by IMS
  - Many times FIELD only defined for sequence fields
  - Data content not enforced by IMS
- Where are field descriptions defined?
  - IMS Catalog
  - Copy books
  - JAVA Classes
- Non-unique or non-keyed segments

IMS Database



DB2 Tables

&schema.Part_Master

Part_No	Part_Description

&schema.Standard_Info

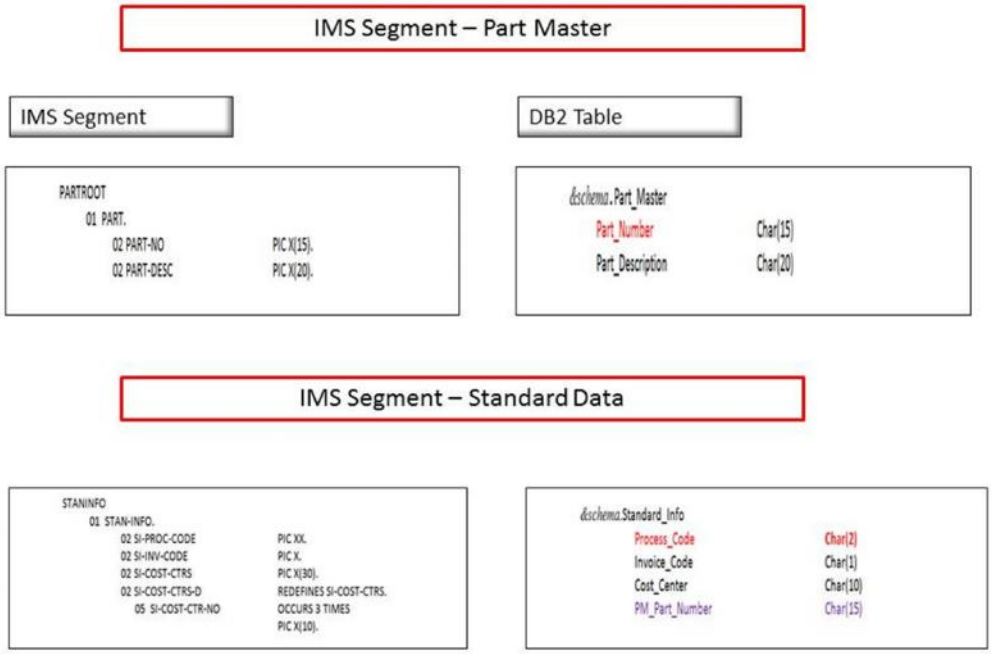
Process Code	Invoice Code	Cost Center	PM_Part_no

&schema.Stock_Status

Area	Dept	Project	Division	PM_Part_no

Flattening IMS Database Records

- Concatenated Keys
  - Concatenated key fields not stored with segment data
  - Key fields needed for each row to maintain referential integrity

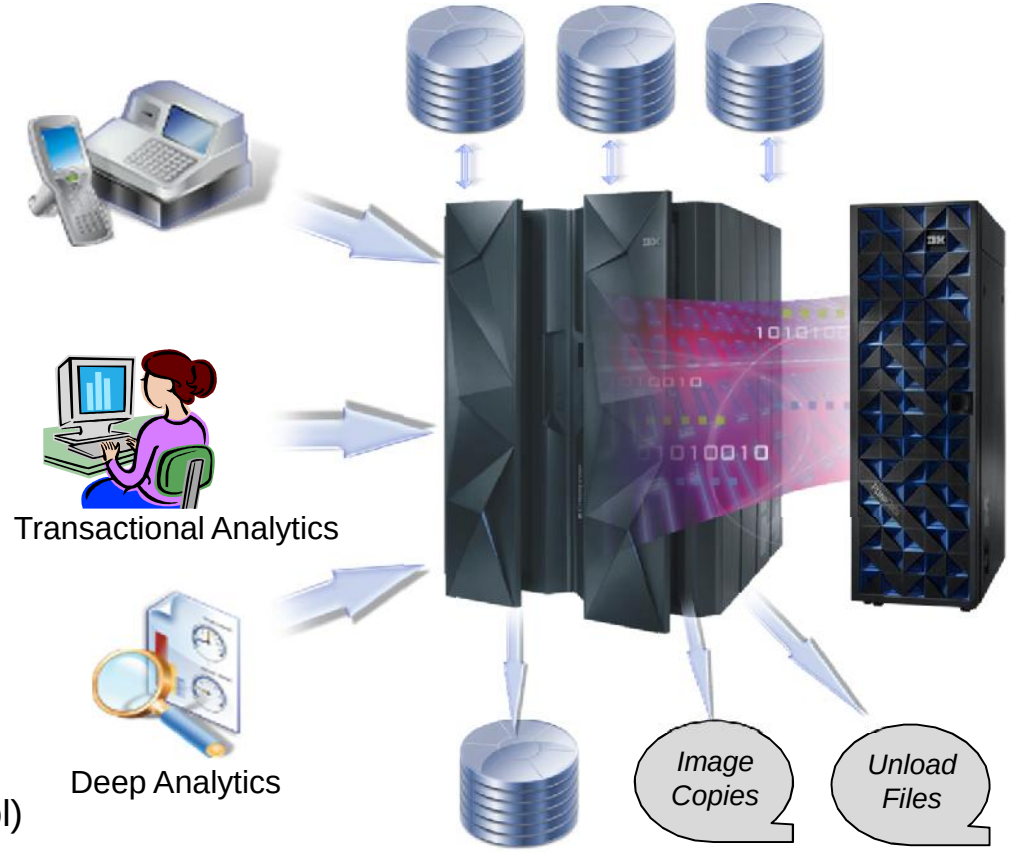


- OCCURS clauses
  - Multiple instances of a field in a single instance of a segment
  - Multiple 'rows' should be generated

```
STANINFO (Standard data)
01  STAN-INFO.
      02 SI-PROC-CODE     PIC XX.  <-Key
      02 SI-INV-CODE      PIC X.
      02 SI-COST-CTRS     PIC X(30).
      02 SI-COST-CTRS-D REDEFINES SI-COST-CTRS.
         05  SI-COST-CTR-NO OCCURS 3 TIMES
             PIC X(10).
```

Extraction Considerations and Methods

- Considerations
  - Availability requirements
  - Frequency
  - Impact to OLTP workload
  - What data is needed?
    - Entire database record?
    - Certain segments?
    - Data from multiple databases
    - Consistent point in time
- Extraction Methods
  - IMS Application
    - Additional online workload
    - Data can still be changing
  - Database Clone (IMS Cloning Tool)
    - Group of databases at a point in time
    - DLI applications
  - Image Copies/Unload Files
    - Additional knowledge of data set structure needed



Transforming Non-Relational Data

- Transformation may need to be done for each field of each segment
  - Data types
  - Flattening
  - OCCURs
- Transformation is typically most CPU intensive portion of ETL
  - Analysis and operation performed on smallest entity
- Accelerator Loader inputs
  - DB2 unload file format
    - All fields/columns are in native DB2 data type
  - Data types can be described to Loader
    - Loader will transform data to DB2 format during load

How to manage Big Data for IMS

IMS Automated Data Base Solutions

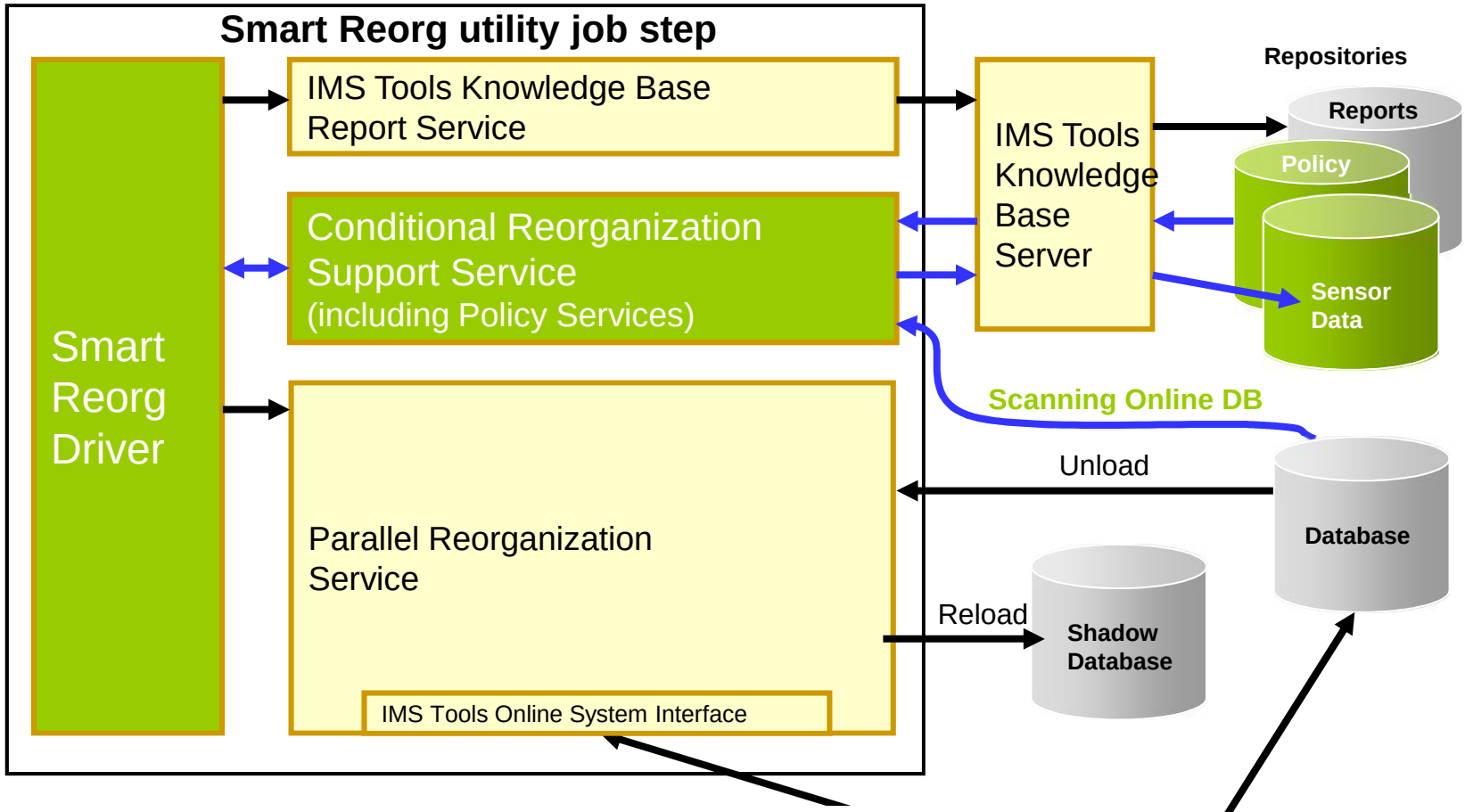
- Checks data base status on a regular basis
  - User specified thresholds for key indicators
- Performs reorganization only when necessary
- Performs auxiliary functions: IC, PC, IB, etc.
- Keeps data bases performing optimally
- Saves human resources
- Saves computer resources
- Cost efficient solution for both predictable and unpredictable data base growth and activity

Two Approaches = Single Solution

- Conditional Reorganization
  - User/scheduler initiated job submission
  - Immediate Sensor Data Collection from Data Base
  - Evaluation of Sensor Data versus Policy
  - Decision to Reorganize or Quiesce
  - IMS Data Base Solution Pack Reorganization Expert
- Autonomic Reorganization
  - System initiated job submission
  - Periodic Sensor Data Collection from Data Base
  - Periodic Evaluation of Sensor Data versus Policy
    - Passive = Recommendations only
    - Active = Initiate and manage Autonomic Reorganization
  - IBM Base Pack IMS Autonomics Director
    - No charge

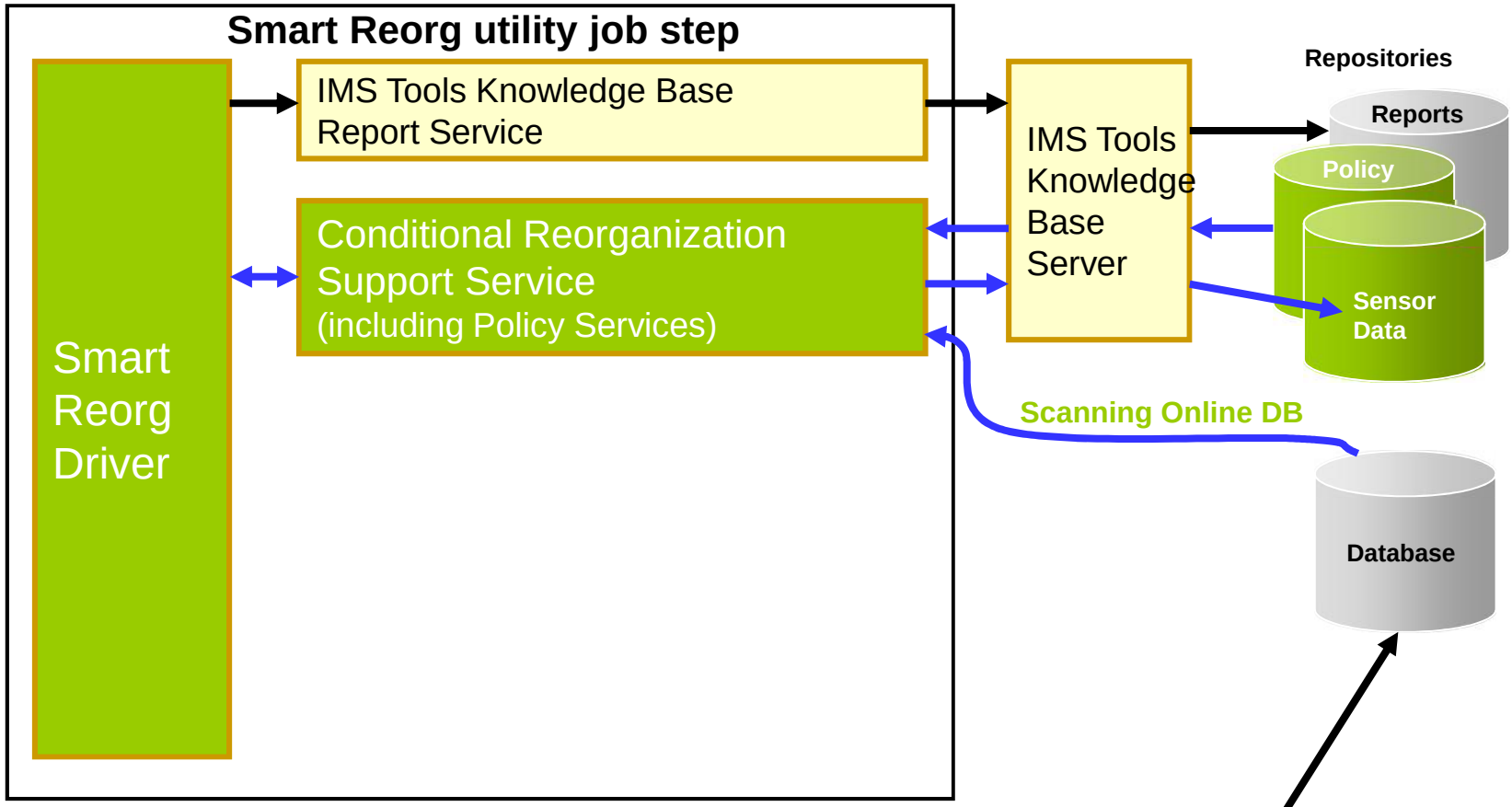
Getting the Most from Conditional Reorganization

Smart Reorg utility in Reorg Expert

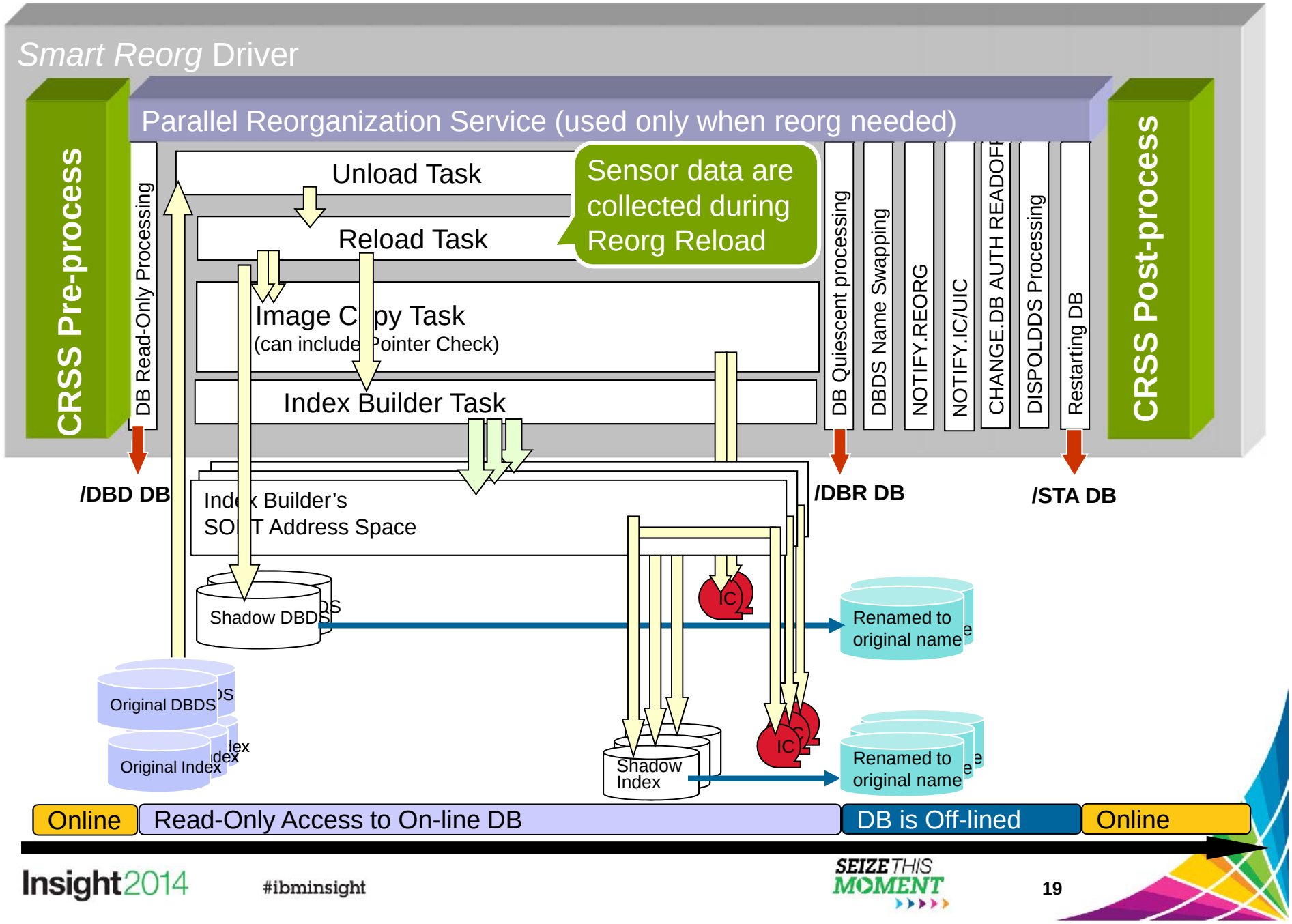


- **Conditional Reorganization Support Service (CRSS)** provides extended features
- Extended services are built on the IMS Tools Knowledge Base (IMS Tools KB) and Policy Services infrastructures

Smart Reorg utility in Diagnosis Only mode

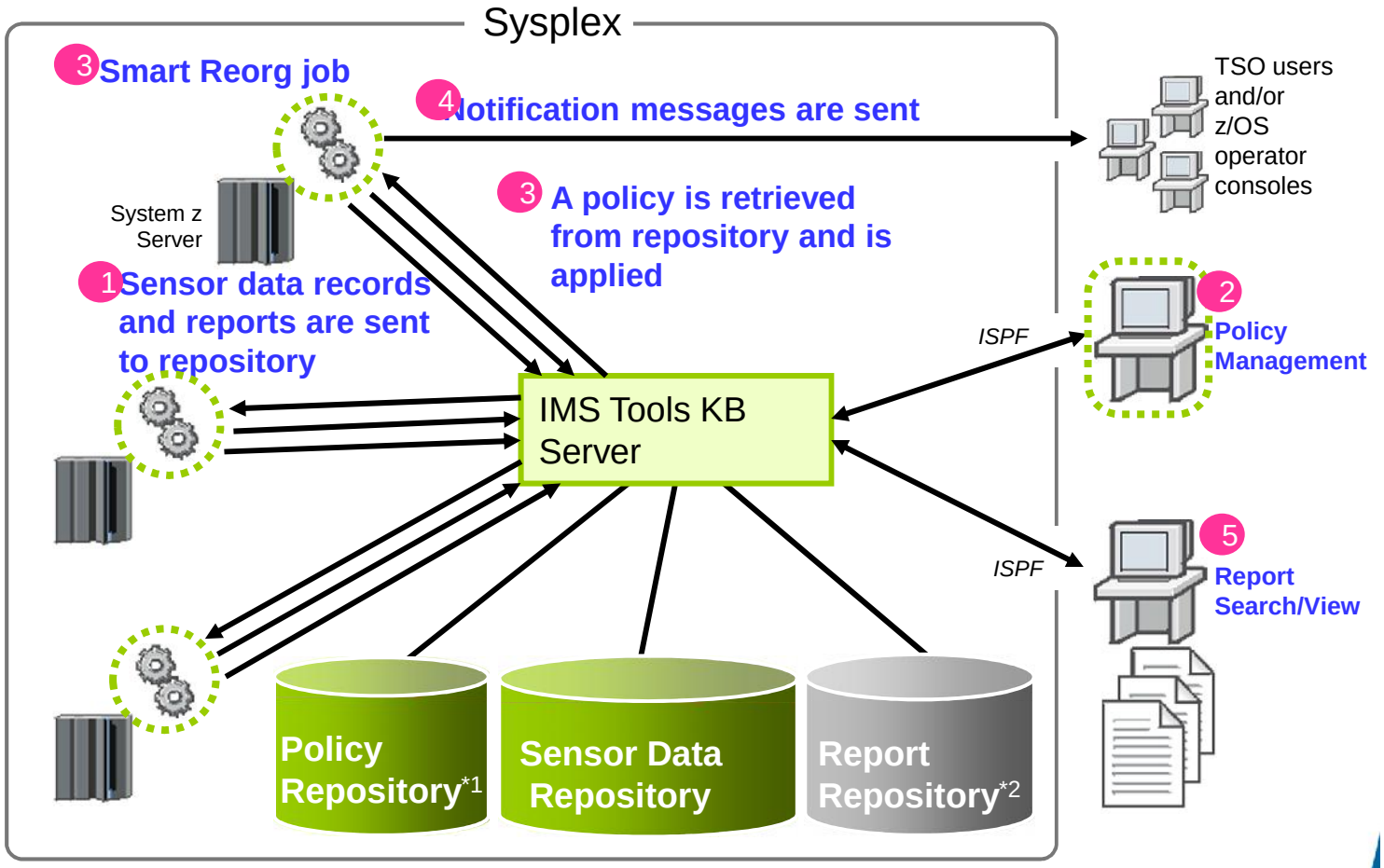


- *Smart Reorg Driver* supports diagnosis only mode, where database exceptions and reorganization need are checked and notified but no reorganization is performed


Smart Reorg Driver
CRSS Pre-process
Parallel Reorganization Service (used only when reorg needed)
CRSS Post-process
DB Read-Only Processing
Unload Task
Reload Task
Image C py Task
(can include Pointer Check)
Index Builder Task
Sensor data are collected during Reorg Reload
DB Quiescent processing
DBDS Name Swapping
NOTIFY.REORG
NOTIFY.IC/UIC
CHANGE.DB AUTH READOF
DISPOLDDS Processing
Restarting DB
/DBD DB
/DBR DB
/STA DB
Ind x Builder's
SO T Address Space
Shadow DBDS
IC
Renamed to original name
Original DBDS
Original Index
Shadow Index
IC
Renamed to original name
Online
Read-Only Access to On-line DB
DB is Off-lined
Online

Smart Reorg utility features at a glance

1. **Sensor Data Collection**
2. **Reorg policy Definition**
3. **Conditional Reorganization**
4. **Exception Notification and Reporting**
5. **Tracking exceptions and reorgs**



- All information are stored in and managed by IMS Tools KB repositories
- Sysplex-wide access to these repositories is supported by IMS Tools KB Server

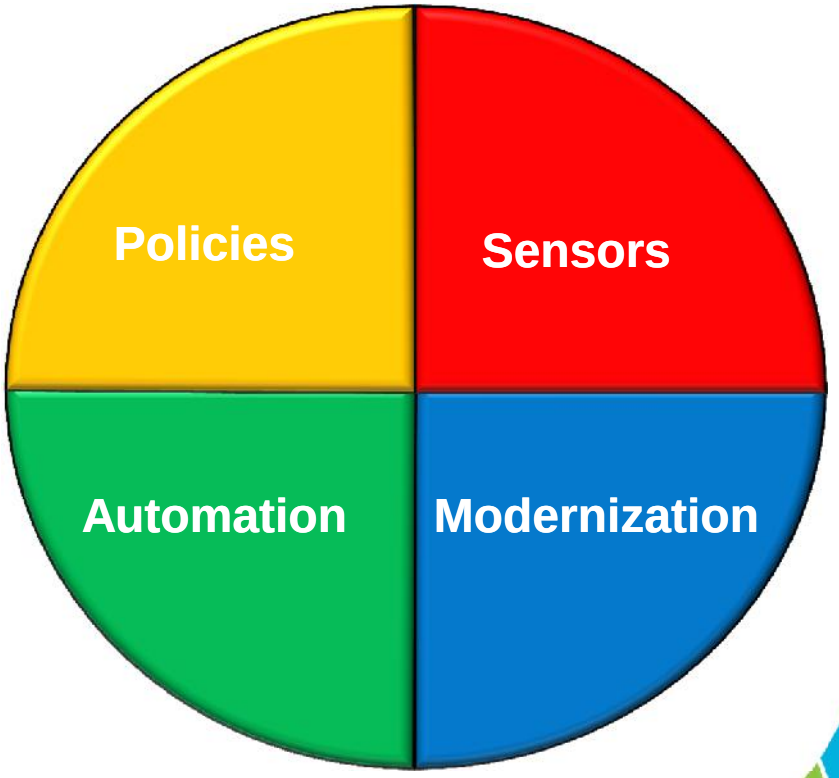
*1: ITKB Input Repository is used as the Policy Repository.
*2: ITKB Output Repository is used as the Report Repository.

Getting the Most from Autonomics

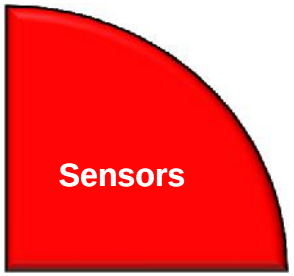
IMS Tools Autonomics Vision

Putting information to work

- Sensors collect resource statistics
- Policies evaluate sensor data and identify potential problems
- Automation orchestrates the collection and evaluation of sensor data
- Modernization presents an interactive modern interface for managing the system

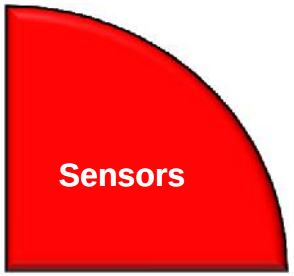


Sensors: Collecting the Basic Information You Need



- Statistical point-in-time sensor data on your FF/FP Databases
  - Stored in IMS Tools Knowledge Base repository
  - Historically maintained per user specifications
  - Over 60 separate data elements related to space usage, optimization, and fragmentation
    - data set extents, DASD volume usage, data set free space, roots distribution, RAP usage, CI/CA splits, and IMS free space, etc
- Two methods of collection:
  - Standalone database Sensor utilities for full-function and Fast Path databases
  - Integrated with existing IMS Tools
- Integrated Tools support
  - High Performance Image Copy, High Performance Pointer Checker
  - Fast Path Analyzer, Fast Path Online Pointer Checker

List of Full Function sensor data collected



Database Record Statistics (per database or HALDB partition)

▪ Nbr. of DB records	▪ Avg. DB record length		

Randomizer Statistics (per HDAM or PHDAM partition)

▪ Nbr. of total RAPs	▪ Nbr. of unused RAPs	▪ % of number of unused RAPs	▪ Nbr. of synonyms
▪ % of number of synonyms	▪ Nbr. of root not on home block	▪ % of root not on home block	▪ % of segment data in overflow
▪ Nbr. of roots in overflow	▪ % of number of roots in overflow	▪ Bytes of segments in RAA	

Volume/Extents Statistics (per data set)

▪ Allocation type (CYL, TRK, …)	▪ Primary allocation amount	▪ Secondary allocation amount	▪ SMS-managed or not
▪ Max. nbr of extents for the d.s.	▪ Max. nbr. of extents for the volume	▪ Nbr. of extents allocated	▪ Nbr. of volumes used
▪ Nbr. of unused volumes	▪ Nbr. of unused assigned volumes	▪Nbr. of unused candidate volumes	
▪ Nbr. of available remaining extents determined by the max. nbr. of data set extents and the max. nbr. of extents available on volumes assigned to the data set			

Data Set Space Usage Statistics (per data set)

▪ Block/CI size	▪ Nbr. of blocks/CIs used	▪ Max. size of the data set	▪ % of data set size against the max.
▪ High-Allocated-RBA	▪ High-Used-RBA		

IMS Space Utilization Statistics (per data set)

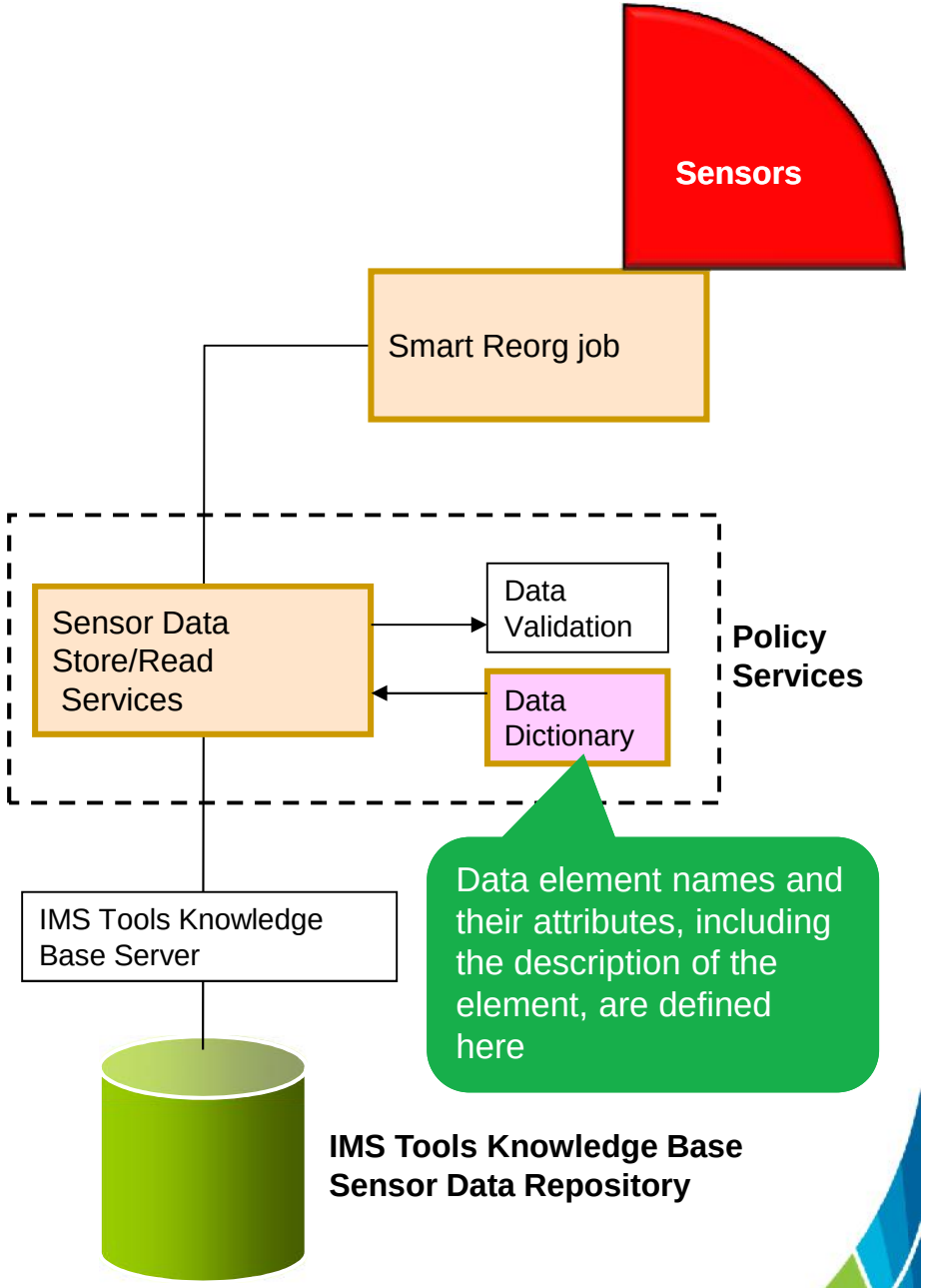
▪ Total bytes of segment data	▪ Total bytes of free spaces	▪ Total bytes of slack bytes	▪ % of free spaces
▪ % of segment data	▪ % of unused bytes in the data set	▪ Total nbr. of segments	▪ Total nbr. of VL segments
▪ Total nbr. of VL-split segments	▪ % of nbr. of VL-split segments	▪ Total nbr. of slack bytes	▪ Avg. nbr. of slack bytes per block
▪ Total nbr. of FSEs	▪ Avg. nbr. of FSEs per block	▪ Nbr. of FSEs valid for shortest segments	▪ Nbr. of FSEs valid for longest segments
▪ Avg. nbr. of non-reusable FSEs	▪ Total nbr. of pointers	▪ Total nbr. of ptrs pointing external block	▪ % of nbr. Of ptrs pointing ext. block

HISAM/SHISAM Statistics (for HISAM)

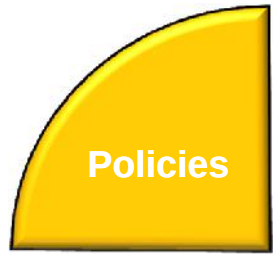
▪ Logical record length	▪ Total nbr. of CI splits	▪ % of nbr. of CI splits	▪ Total nbr. of CA splits
▪ % of nbr. of CA splits	▪ Total nbr. of HISAM delete bytes	▪ % of nbr. of HISAM delete bytes	

Sensor Data Repository

- The sensor data is stored in the *Sensor Data Repository* as records made up of *data elements*
- The data record is stored in a well-understood and flexible format
  - This allows its use years and multiple product releases later in time
- The data and its format is understandable between products and releases to ensure reliable functionality



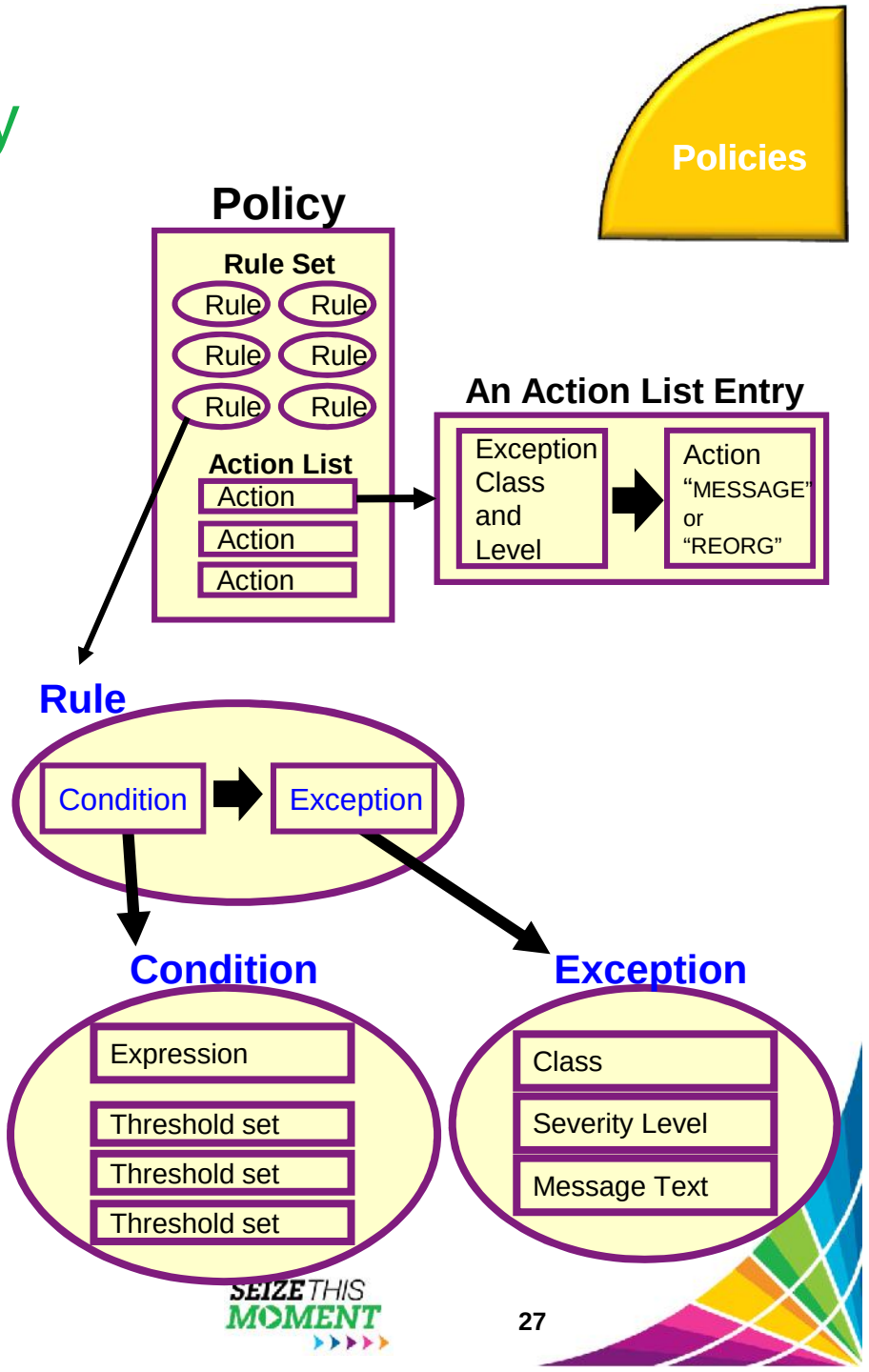
Policies: Using Sensor Data to Make Decisions



- Policy definitions are used to evaluate specific database states
  - Threshold values are compared against sensor data for a given database or group of databases
  - When thresholds are met or exceeded, exceptions occur
- Works “out of the box”
  - Ships with predefined policies and threshold values
  - Full ISPF interface provided for policy management
- Customizable to fit your shop
  - You can define your own sets of threshold values
  - Customize the messages sent when exceptions do occur
  - Specify who receives which messages and how
    - WTO, e-mail, or text

Major components of a policy

- Policy has two major components:
  - **Rules** that detect **exceptions**
  - **Exception-to-Action mapping**
- Rule Set for exception detection
  - Rule has two elements:
    - **Condition** (a threshold check formula)
    - **Exception** (a named state of a DB)
- Action List for action mapping
  - An Action List entries defines an exception-action mapping
  - The sequence of Action List entries defines whether to reorganize the subject database



Exception detection condition is defined in a rule

Policies

Sample Data Elements

DB_PCT_OF_MAX_DS_SIZE

The percentage of allocated bytes (bytes for High Allocated RBA) compared to the maximum size (4 GB or 8 GB).

DB_PCT_BYTES_FREE_SPACE

The percentage of bytes of total free spaces to the total used bytes for the data set.

A Sample Condition Description

```
Help
REORG/OPERATION                    Evaluation Formula Descrip Row 1 to 10 of 10
Command ===>

Rule name . . . . . : IBM.DBDS_GROWTH.20    Locale . . : $IVP
Value set for threshold . : MED
&1=85, &2=20,
 Evaluation formula description
Both of the following thresholds have been reached or
exceeded in a database data set. This condition indicates
the possibility that high percentage of unusable free
spaces has caused the growth in data set size.
 - Threshold on the percentage of data set size against
   its allowable maximum size:
     &1(85)
 - Threshold on the percentage of total free spaces against
   the used space that is allocated for the data set:
     &2(20)
********************************* Bottom of data ********************************
```

A Sample Set of Threshold Values

```
Commands  Help
DOMAIN: REORG                      View Threshold Values      Row 1 to 2 of 2
Command ===>

View threshold values and press End to exit.

Locale . . . . . : $IVP      Rule name  : IBM.DBDS_GROWTH.20
Value set for threshold : MED
ID#     Value                          Description
&1   85          Numeric, range: 0 to 100
                 The percentage of allocated bytes (bytes for High allocated
                 RBA) in the maximum size (4 GB or 8 GB).
&2   20          Numeric, range: 0 to 100
                 The percentage of bytes of total free spaces compared to the
                 total used bytes for the data set.
******************************** Bottom of data ********************************
```

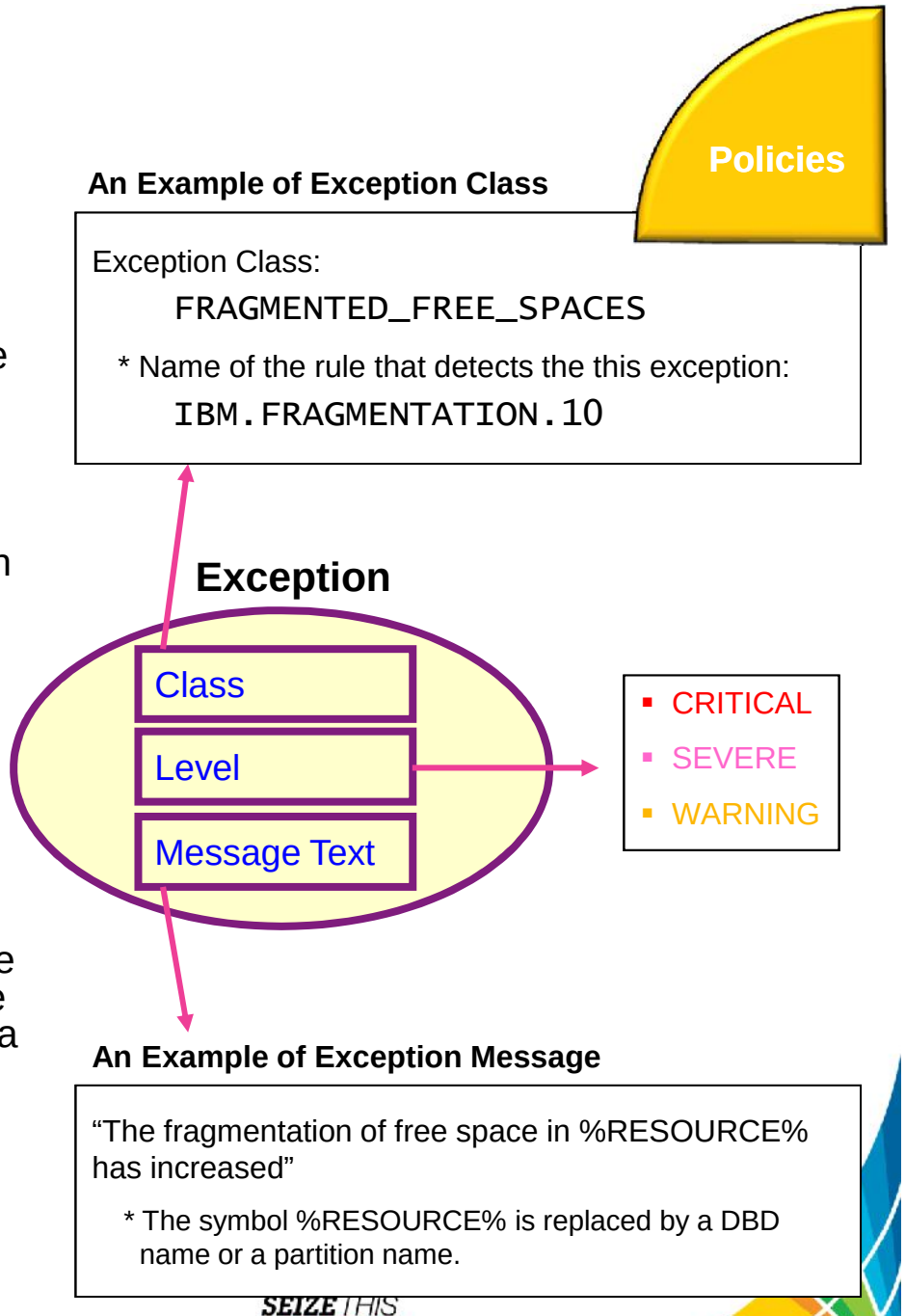
Threshold Set

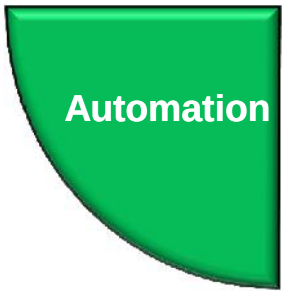
A named set of threshold values for the threshold variables that are referred to in the condition descrition above is called *a threshold set*.

"MED" = &1 = 85, &2 = 20 ← You can tweak these threshold values

Attributes of an exception

- **Exception class**
  - Represents the specific database event category being monitored
- **Exception severity level**
  - Is a category representing the severity of the detected exception
  - There are fixed three levels:
    - WARNING
    - SEVERE
    - CRITICAL
- **Exception message**
  - Is the text that can be used by the resulting policy action to describe the database event that crossed a rule threshold set
  - Users can modify the message text

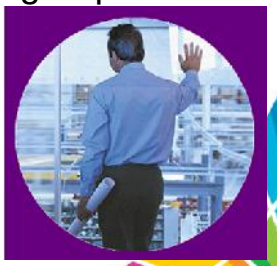




Automation: Delivering on our Vision

- IBM Tools Autonomics Director 1.3 (Passive)
  - Automates collection and analysis of Sensor Data
  - Recommends when databases should be reorganized
    - With email or text notifications
  - Provides a scheduling feature that allows you to control how frequently sensor data is collected and how frequently policies are evaluated
  - Flexible scheduling around pre-defined PEAK times

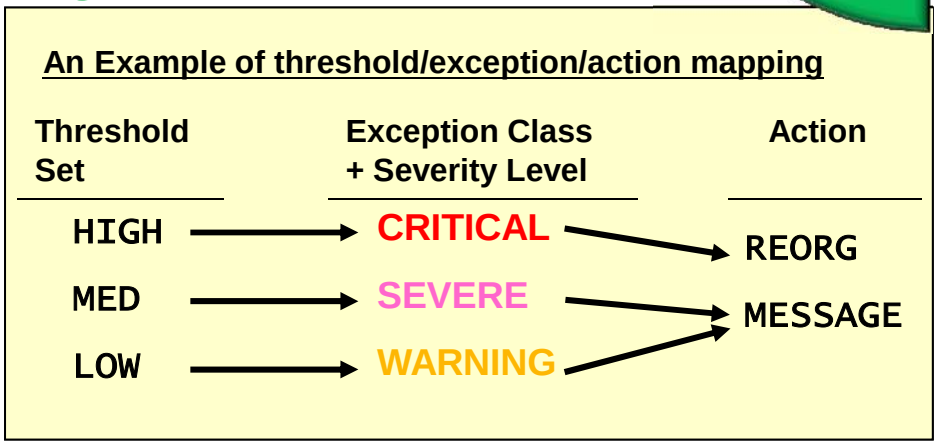
- IBM Tools Autonomic Director 1.4 (Active)
  - Actively initiate recommended actions on user-defined database groups
    - Discovery feature for identifying related database groups
    - Ability to manage and coordinate reorganization of multiple IMS database groups as if reorganizing a single database
    - Flexible scheduling only in pre-defined Maintenance windows



Exception-to-Action mapping

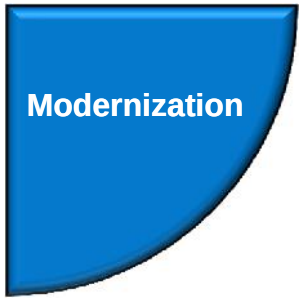
- An *action* is the result of a rule condition being reached or exceeded during a policy evaluation
- A rule threshold set has been mapped to a severity level for the exception class associated with the rule
- In turn, the severity level is mapped to an action

Note: In IBM-provided REORG policies, severity-level-to-action mappings are fixed for each exception class and are not customizable.

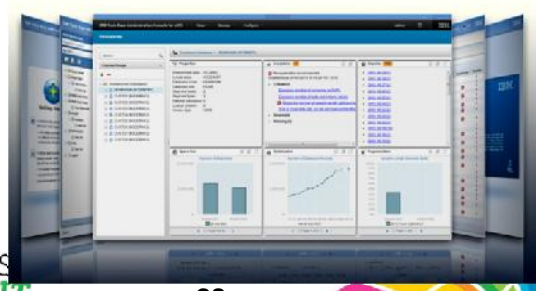



```
 Commands  Help
REORG/OPERATION            Associate Actions With Rule Thres Row 1 to 3 of 3
Command ===>

Select actions. Then press Enter to be prompted to choose the associated rule
thresholds. Press End to cancel all selections.
Locale  . . : BSNGLOBL  Policy name  . . : SYS.DBDTYPE.HDAM
Locale  . . : BSNGLOBL  Rule name  . . . : IBM.DBDS_GROWTH.20
Description : Simple rule on the size of data sets that have certain

A: Row Actions: S - Select Actions. (You will then be prompted to choose
                    thresholds from a list.)
                U - Unselect.

S: Status:      S - Selected.
                O - Pre-selected from original policy. (Update only).

A   S  Action        Level         Threshold
_   O  REORG         CRITICAL      HIGH
_   O  MESSAGE       SEVERE        MED
_   O  MESSAGE       WARNING       LOW
F1=Help      F3=End       F5=RFind     F7=Up        F8=Down      F10=Actions
F12=Cancel
```

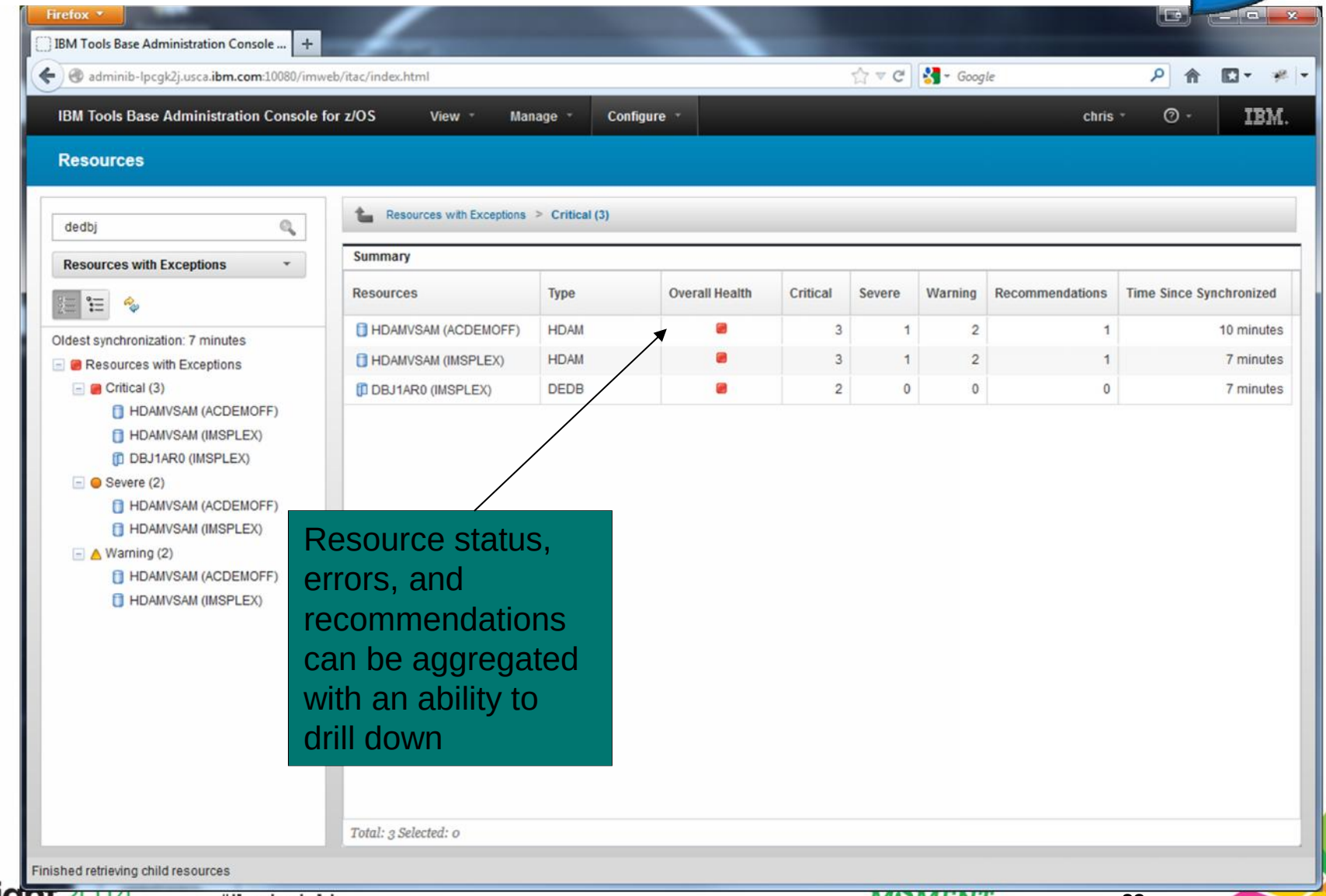
IMS Management Console Goals



- Provide a single holistic, easy-to-use interface to manage IMS systems and databases
  - Consolidate information from various tools to paint a more complete picture of IMS systems and databases
  - Leverage the latest web technologies for a richer user experience
  - Access from anywhere via the Internet using standard web browsers
  - Prepare the next generation of IMS DBAs and System Programmers through an integrated, context sensitive help system
- Begin with integration of our Autonomics Solutions
  - …Extend integration to support all our IMS Tools



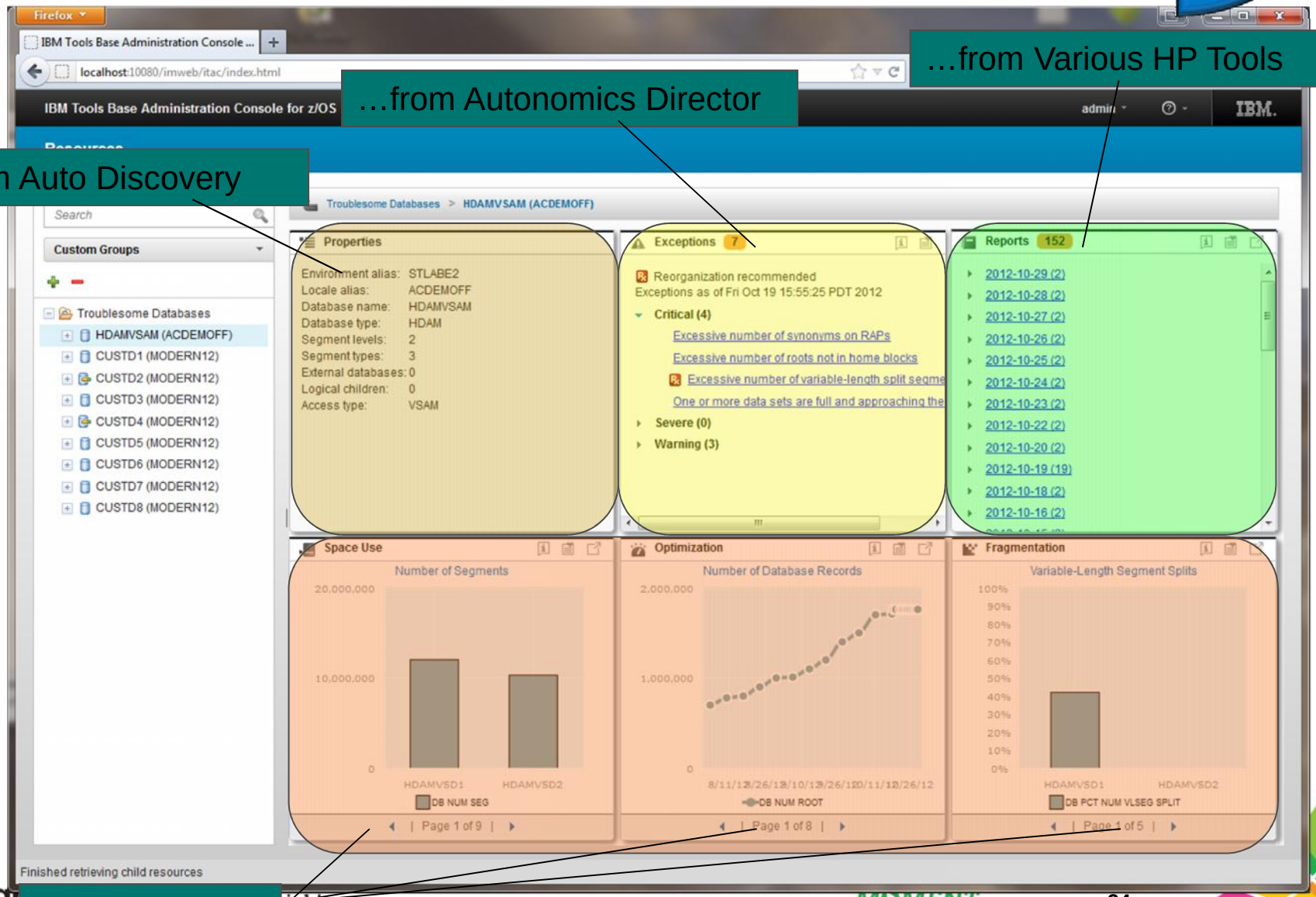
Drill down on Exceptions from an Enterprise-wide View



Resource status, errors, and recommendations can be aggregated with an ability to drill down

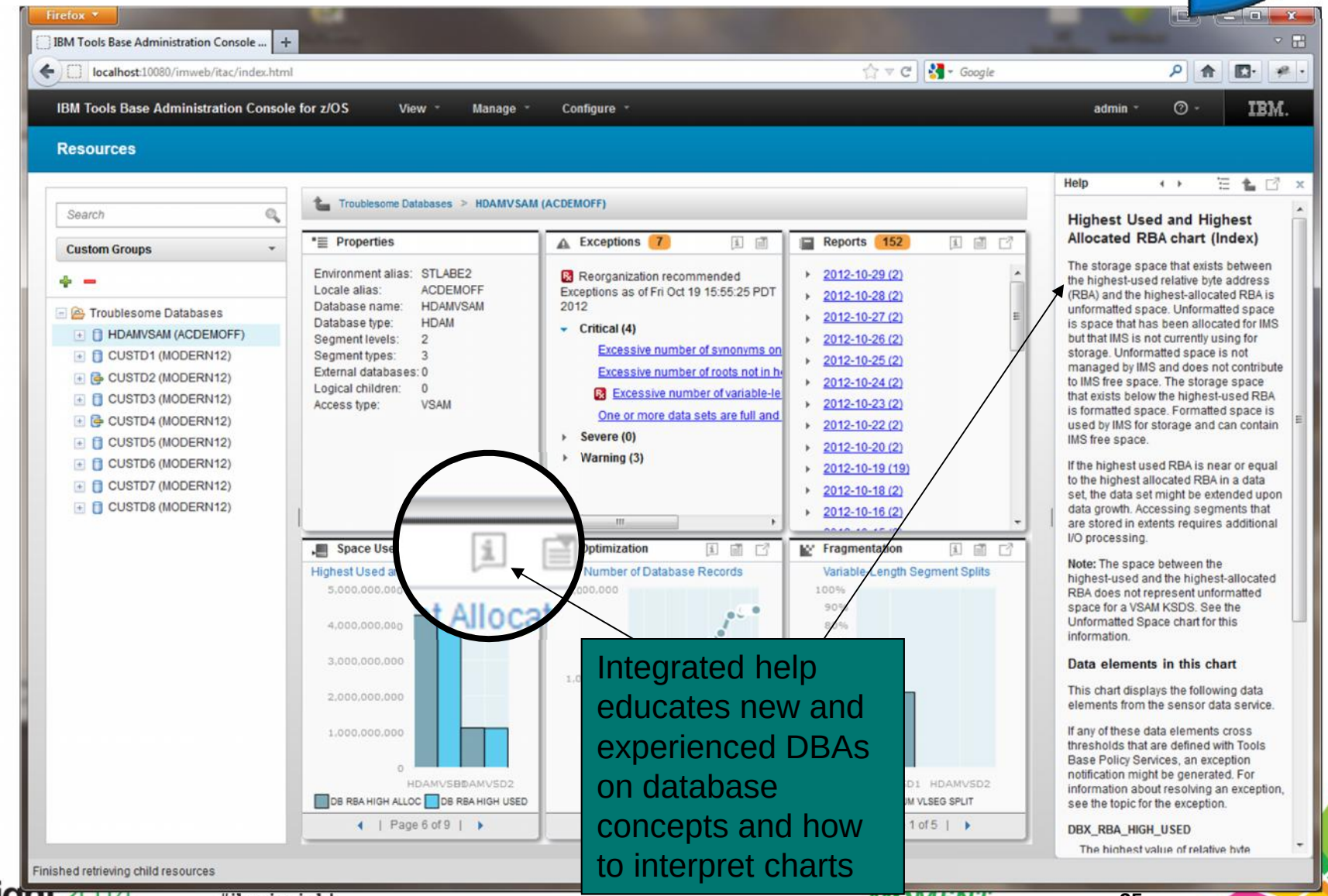
Holistic View of IMS Databases

Modernization



Integrated Help Throughout

Modernization



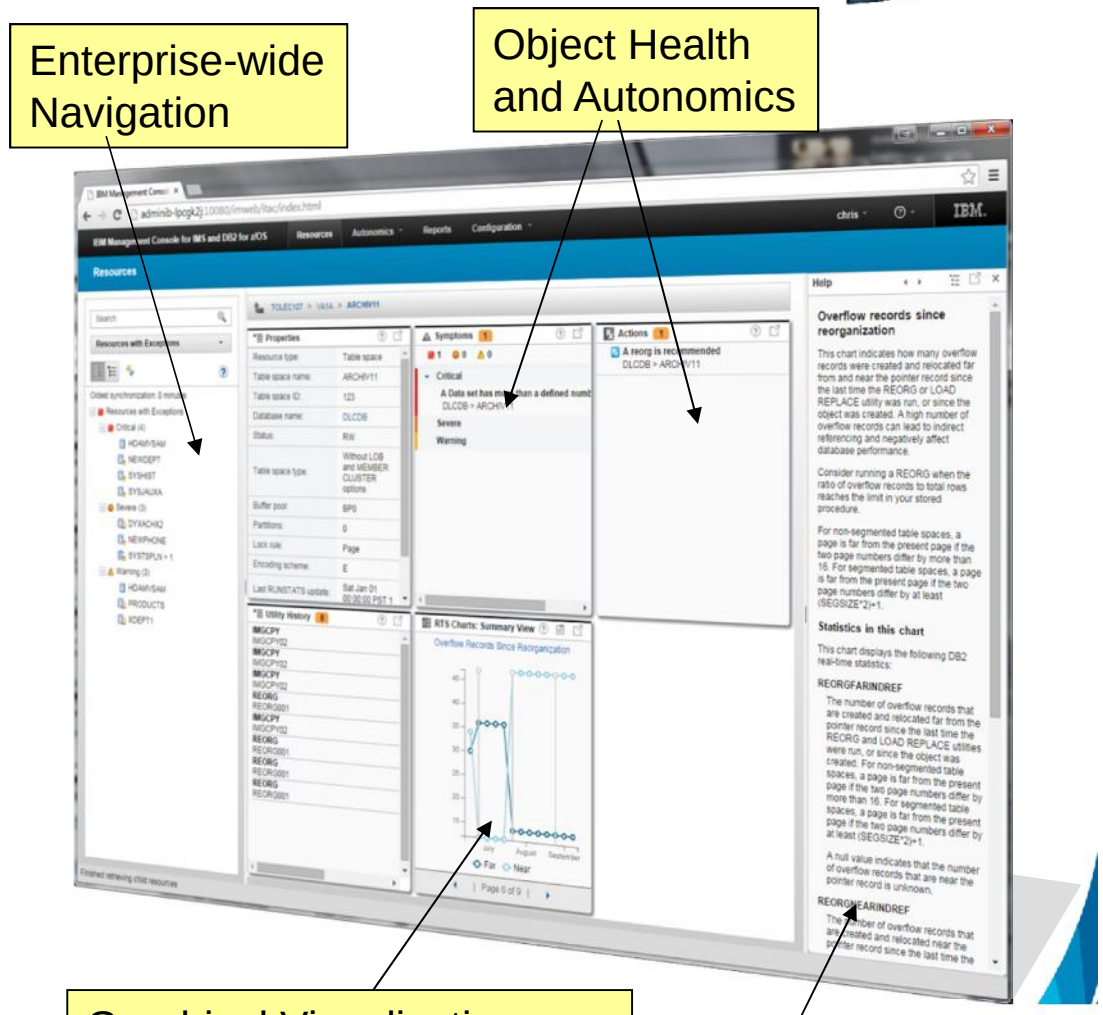
Integrated help educates new and experienced DBAs on database concepts and how to interpret charts

IBM Management Console
for IMS and DB2 for z/OS

Modernization

- **Provides a single, holistic easy-to-use interface to manage IMS and DB2**
  - Zero-install web-based interface
  - Consolidate information from IMS, DB2 and tools to from across the entire enterprise
  - Reduced time for problem identification and resolution through tight integration with IMS and DB2 Autonomics
  - Dramatically reduced learning curve for new users of IMS and DB2

- Now a separate product available *no-charge* ***(5655-TAC)***
  - Extensible by growing number of products and solution packs adding additional value



IBM Management Console for IMS and DB2 for z/OS

Modernization

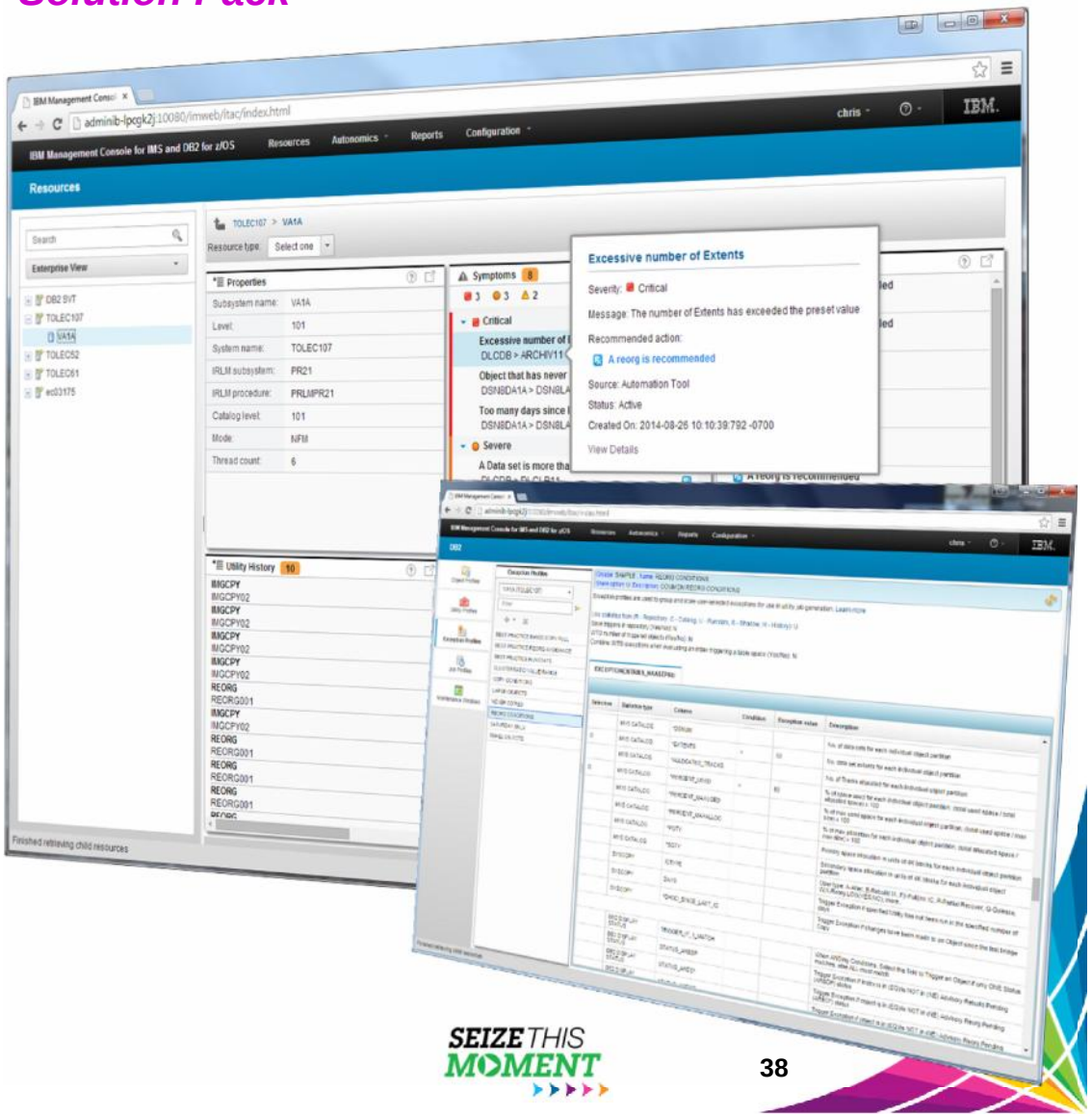
- Progressive drill down through variety of DB2 object dashboards
- **Autonomics Director for DB2 for z/OS** (in the *no-charge* Tools Base) enables:
  - Charting of DB2 object statistics through RTS snapshots with
  - Autonomics control to define profiles and maintenance windows
  - Integrated support for the DB2 Admin Task Scheduler

IBM Management Console for IMS and DB2 for z/OS

Modernization

Extended with the DB2 Utility Solution Pack

- Identification and Diagnosis of symptoms and recommended actions for REORGs, ICs, Runstats
- Reporting on historical utility execution including timestamp, elapse time, system output, etc
- Graphical interfaces to define Automation Tool Object, Utility, Exception, and Job Profiles



IBM Management Console for IMS and DB2 for z/OS

Modernization

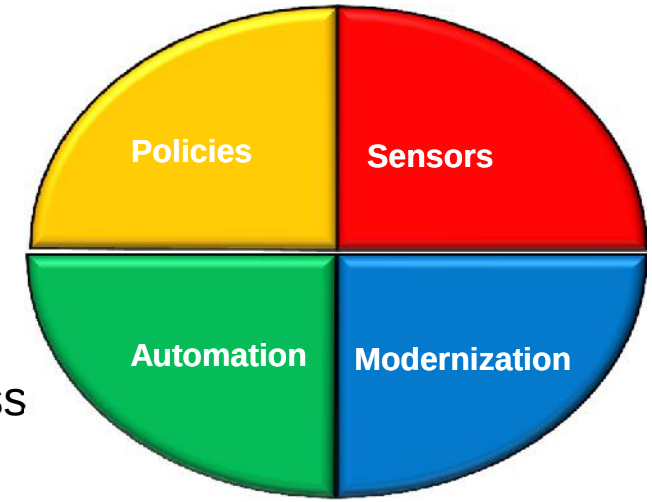
- Quickly identify and drill down to databases and objects that need your attention from a single starting point
- Easily manage by exception and recommendation, taking action before problems occur
- Rapidly interpret statistical trends to verify and project
- Shorten the learning curve for new administrators

- …all from a **unified IMS and DB2** interface

Consider a combined strategy

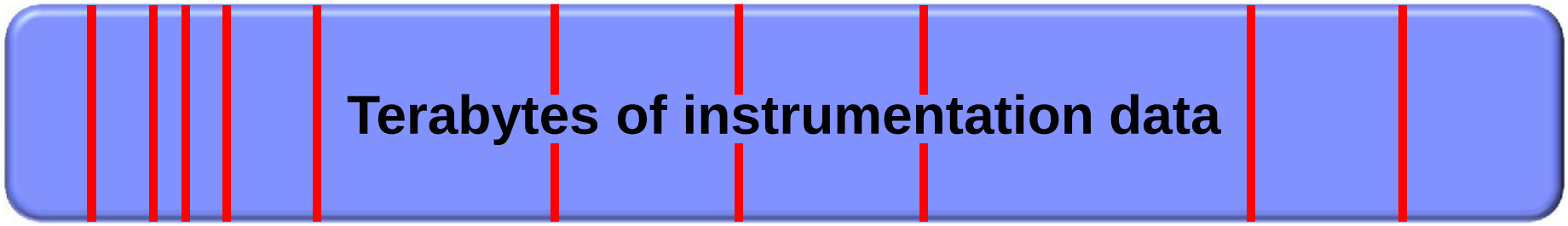
Use for appropriate situation

- Conditional Reorganization for environmental compatibility issues
  - Mainly Job scheduler mandates
- Autonomic Director
  - In Passive Mode for health check between scheduled reorganizations to detect anomalies
  - For On Demand requests for DB status to address perceived performance issues
- Phased approach is best
  - Gain experience with a small subset of data bases
  - Consider using passive mode first
  - Migrate to active mode when comfortable



Diagnosing Issues with Big Data for IMS

Problem: Instrumentation data can be a BigData problem

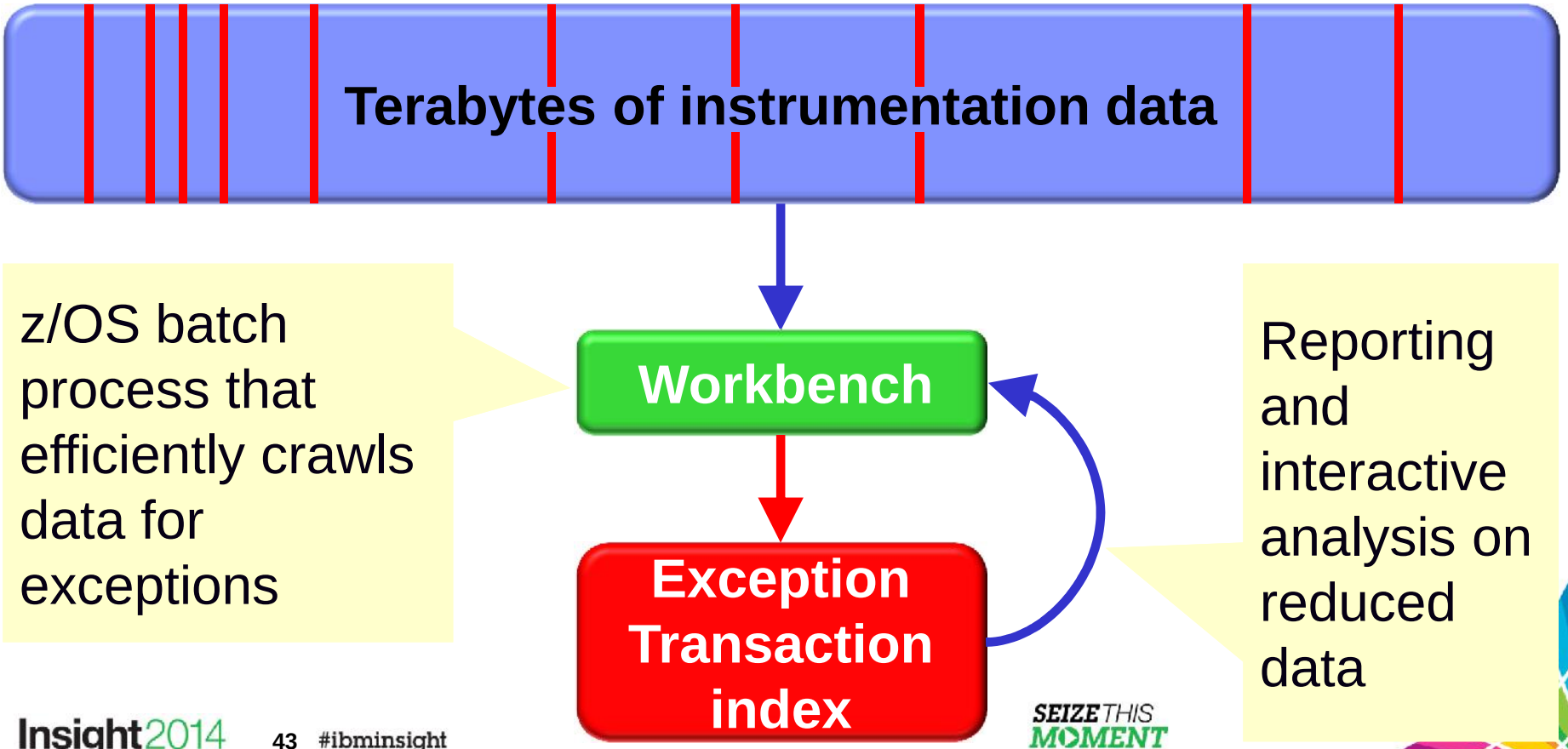


To optimize transaction performance analysis, we need to specify which performance metrics constitute an "***exception***", and quickly separate them from the bulk of "normal" instrumentation data.

- Today's z systems create vast amounts of instrumentation data
- Good transaction performance monitoring may identify possible issues before they become critical and regardless of where they execute

Solution: Workbench exception processing

Exception: a transaction that matches specific *exception criteria*, such as long response time or an abend



Workbench supports all the major subsystems

IMS	CICS	DB2	WebSphere MQ and WAS	z/OS
IMS log and trace	CMF performance class (SMF 110)	DB2 log	MQ log extract	SMF
IMS monitor	CICS trace	DB2 accounting, statistics and performance trace (IFCIDs)	MQ statistics (SMF 115-1, -2)	OPERLOG / SYSLOG
CQS log stream			MQ accounting (SMF 116)	
IMS Connect event data (collected by IMS Connect Extensions)			WAS request activity performance statistics (SMF 120-9)	
OMEGAMON XE for IMS				

z/OS transactions in BigData

Workbench can provide all or a subset of transaction performance data, where BigSheets then has the ability to correlate across subsystems.

CICS

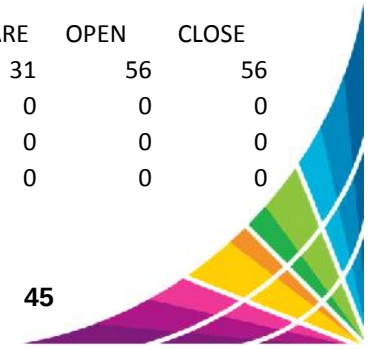
TIME	APPLID	Tran	Dispatch	User CPU	Suspend	Task No	Dispatch	CPU	Start	Stop	Response	User	DB2	IMS	SYNCPT
10:27:11	FUWTCIC	FB66	2.32653	0.00844	0.000305	665	0.002711	0.002501	10:27:11	10:27:13	2.326835	TWM	2.323747	1.256212	0.001742
11:03:02	FUWTCIC	FB66	6.321437	0.011625	6.882225	673	0.010524	0.007094	11:03:02	11:03:15	13.20366	TWM	6.310697	2.363512	0.002148
11:03:22	FUWTCIC	FB66	3.04043	0.007203	0.00051	675	0.018579	0.004358	11:03:22	11:03:25	3.04094	TWM	3.021734	1.298187	0.002322
11:03:34	FUWTCIC	FB66	3.025195	0.007013	0.00056	677	0.005939	0.004237	11:03:34	11:03:37	3.025755	TWM	3.019117	1.126172	0.002379

IMS

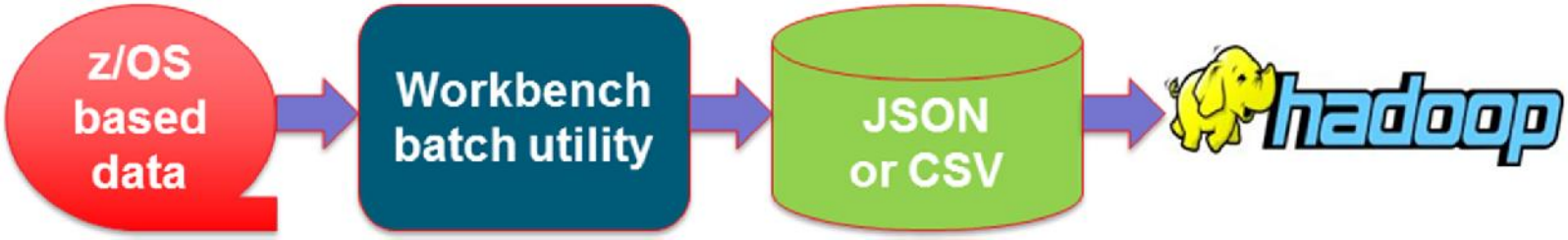
TIME	TranCode	Program	User	Input Q	Process	Output Q	Total	Response	Schedule	CPU time	SYNCPT	FF Get	FF Update	FP Get	FP Update
11:29:18	FBOIAT42	FBOIAP42	JOHN	0.04457	0.065543	0.00003	0.110143	0.110143	0.04447	0.035142	0.002053	10	12	4	6
11:29:30	FBOIAT42	FBOIAP42	JAMES	0.000503	0.047281	0.000028	0.047812	0.047812	0.0004	0.036641	0.001329	7	2	3	1
11:29:51	FBOIAT42	FBOIAP42	JIM	0.00037	0.042808	0.000029	0.043207	0.043207	0.000231	0.035457	0.001389	8	3	2	2
11:33:59	FBOIAT42	FBOIAP42	DAVID	0.000332	0.134017	0.000028	0.134377	0.134377	0.0002	0.111167	0.001338	23	14	18	11

DB2

TIME	SSID	Start	Stop	Response	CPU	Connection	SELECT	INSERT	UDPATE	DELETE	DESCRIBE	PREPARE	OPEN	CLOSE
11:02:14	DBP6	11:02:05	11:02:14	8.83646	1.733544	DB2CALL	0	48	5	14	22	31	56	56
11:03:15	DBA6	11:03:02	11:03:15	13.1971	0.002569	FUWTCIC	2	0	0	0	0	0	0	0
11:03:25	DBA6	11:03:22	11:03:25	3.035082	0.001609	FUWTCIC	1	0	0	0	0	0	0	0
11:04:01	DBA6	11:03:42	11:04:01	19.431	0.005337	FUWTCIC	3	0	0	0	0	0	0	0



BigData and IT analytics with Transaction Analysis Workbench



IMS Tools are ideally positioned to convert z/OS based logs to CSV or JSON for the BigData analytics engines:

1. Has a knowledge base for all the supported log types (not just IMS; CICS, DB2, MQ and SMF as well); from which all record processing draws the meta-data to process the record
2. Batch CSV or JSON facility that supports very complex record types. No data preparation or intermediary steps are required
3. Understands how transactions are coordinated across all the subsystems, allowing you to correlate different record types
4. Powerful ISPF dialog log browser from where you can visualize the formatted records and learn what they look like.

Want to know what an IMS type 07 log record looks like in JSON?


```
{   "time": "2013-10-11 11:29:18.038109",
    "type": "IMS",
    "code": "07",
    "title": "Application Terminate",
    "data": {
      "DLREC": {
        "DLRLTYP": "07",
        "DLRNPSB": "FBOIAP42",
        "DLRTRNCD": "FBOIAT42",
        "DLRPRTY": "01",
        "DLRTYPE": "01",
        "DLRTIME": 1175,
        "DLREXTIM": 0.035141,
        "DLRAZAAP": 0,
        "DLRCMP": "00",
        "DLRCOMP": "00000000",
        "DLRNJOB": "IDDGMPP3",
        "DLRNSTP": "REGION",
        "DLRMCNT": 1},
```

```
"DLRACCT": {
        "DLRGU1": 4,
        "DLRGN": 6,
        "DLRGNP": 7,
        "DLRGHU": 3,
        "DLRGHN": 4,
        "DLRGHNP": 2,
        "DLRISRT": 12,
        "DLRDLET": 3,
        "DLRREPL": 10,
        "DLRCLCNT": 37,
        "DLRGUMES": 1,
        "DLRGNMES": 0,
        "DLRISMES": 1,
        "DLRPSTNR": "0002",
        "DLRTMEIO": 0.928172,
        "DLRTMEPL": 0.817212,
        "DLRIOCNT": 72,
        "DLRUTC": "2013-10-11 11:29:18.038108"}}}
```

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