

A Systems Architecture Approach to Complex Systems Using mDSM

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Drivers for Analysis via metrics-based Design Structure Matrix (mDSM)

- Complexity of systems
- Maintenance – systems preservation
- Implementation Costs
 - Soft costs
 - Hard costs
- Often prone to failure
- Rationalize architectures and develop appropriate solutions
- Evaluation of quality of architecture

Process for developing mDSM

- System decomposition – break down the system to be analyzed into subsystems of similar parts
- Document the relationship between subsystems and how they interact
 - Semantic Rules
- Note internal and external outputs and inputs that drive the system
- Choose metrics of interest to your study
- Develop a quantification scheme to express metrics
- Render mDSM
- Analyze mDSM

Case ERP Decomposition

- Operations
- Engineering
- Trade Compliance
- Finance
- Human Resources (HR)
- Customer Relationship Management (CRM)

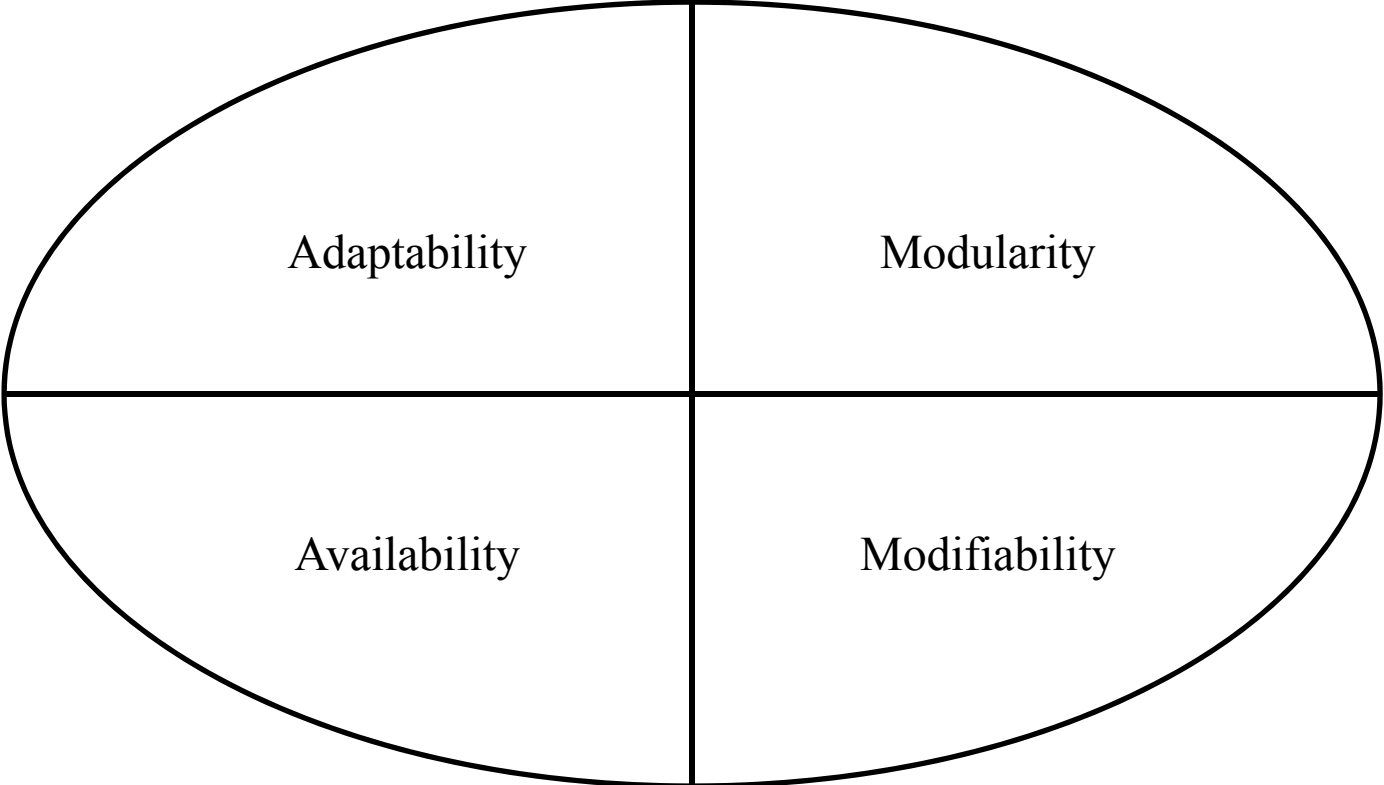
Document relationships among subsystems – Outputs and Inputs

- Seeking direct interactions
- Dependencies
- Internal and external inputs and outputs
- Document via semantic rules

Case ERP Semantic Rules – A Sample

- Shipping makes a direct call on Inventory Management (r:10,c2)
- Shipping makes a direct call on Order Processing (r:10,c:6)
- Shipping makes a direct call on Trade Compliance (r:10,c:6)
- Shipping updates Inventory Management (c:10, r:2)
- Shipping updates Account Receivables (c:10,r:16)
- Makes a direct call – calls a method or service for information, input to a system
- Updates – directly updates a systems, output or writing to a system

Metrics Suite



Metrics Definitions

- Adaptability – the degree to which a product or system can effectively and efficiently be adapted for different or evolving hardware, software or other operational or usage environments.
- Modularity – the degree to which a system or computer program is composed of discrete components such that a change to one component has minimal impact on other components
- Availability – the degree to which a system, product or component is operational and accessible when required for use
- Modifiability – the degree to which a product or system can be effectively and efficiently modified without introducing defects or degrading existing product quality

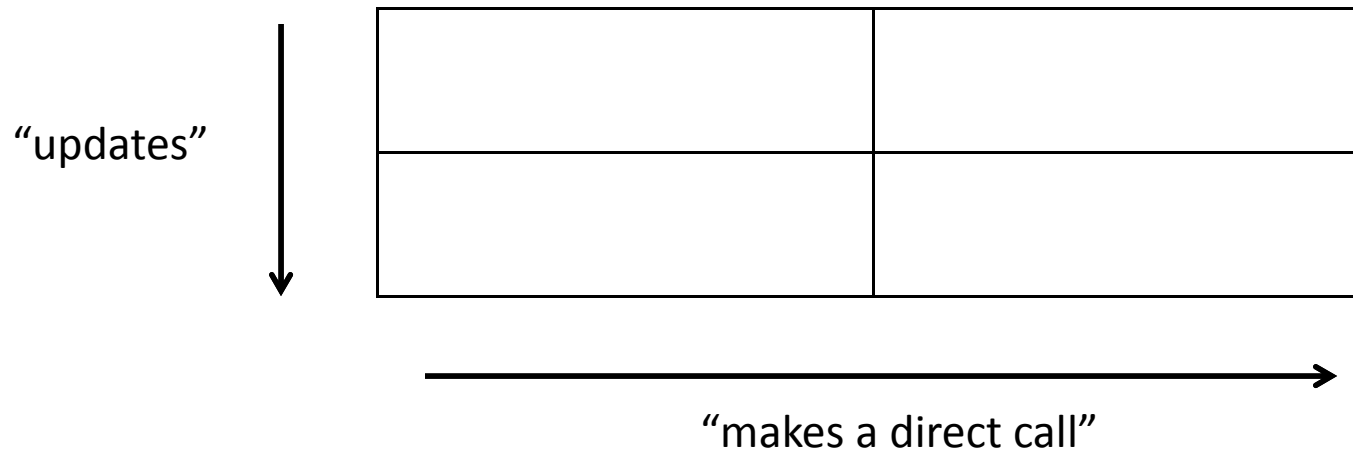
Metrics Quantification

- Weight the impacts to desirable quality attributes
 - Simple scheme to address example – generic
 - Scalable and extensible

0	No impact	No impact to system
1	Minimal impact	Minimal impact to system
2	Severe impact	Severe impact to system

Reading the mDSM

- Traditional DSM, in row (IR)
- Inputs in rows = “makes a direct call”
- Outputs in columns = “updates”
- Walk through of example



mDSM Rendering

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
Capacity Planning	1	1																	2	2	2	2							
Inventory Management	2		2							2	0	2	0							2	2	2	2						
Manufacturing Execution Systems (MES)	3		2	2			2	2																					
Master Planning/Forecasting	4	2	0	2	0				4		2	0																	
Materials Resource Planning (MRP)	5	2	0				5			2	0																		
Order Processing	6	2	0					6			2	0						1	0										
Procurement	7					2	0			7								1	0										
Production Scheduling	8	2	0	2	0			2	0					8													2	2	
Receiving	9		2	0					2	0																			
Shipping	10		2	0			2	0										1	0										
Computer Aided Design	11											11	2	0															
Product Lifecycle Management	12											2	0		12	2	0												
Revision Control	13											2	2		13														
Trade Compliance	14																14												
Accounts Payable	15									2	2						15			2	0								
Accounts Receivable	16										2	2					16			2	0								
Earned Value Management	17										2	2									2	2							
Fixed Assets	18																				18								
General Ledger	19		2	2				2	2							2	0	2	0			19	2	0					
Payroll	20		2	2				2	2							2	2	2	2			20							
Project/Cost Accounting	21																										21		
Time Keeping	22																										22		
Benefits	23																										23		
Learning Management System	24																										24		
Skills Matrix	25																								1	0		25	
Succession Planning	26																								0	0		26	
Customer Relationship Management (CRM)	27																									1	0		27

Benefits

- Ease of use
- Architecture Description and Analysis
- Application Level Analysis
- Change Impact Analysis
- Modularization Analysis
- Quality Analysis
- Traceability Analysis
- Feature Analysis

Drawbacks

- Dependency analysis
- Size of systems may render architecture difficult to display
- Real day to day applicability

Future Work

- Comparison to other models
 - Architecture Tradeoff Analysis Method (ATAM)
 - Architecture Description Language (ADL)
- Solidify basis for metrics selection
- Show extensibility to other systems

List of Acronyms

- mDSM – metrics-based Design Structure Matrix
- DSM – Design Structure Matrix
- ERP – Enterprise Resource Planning system
- CRM – Customer Relationship Management System
- HR – Human Resources
- IR – In Rows
- ATAM – Architecture Tradeoff Analysis Method
- ADL – Architecture Description Language