



# Model-Driven Continuous Deployment for Quality DevOps

*D. A. Tamburri, E. Di Nitto, M. Guerriero,  
M. Artac̣, T. Borovšak*

DICE

Horizon 2020 Research & Innovation Action

Grant Agreement no. 644869

<http://www.dice-h2020.eu>



Funded by the Horizon 2020  
Framework Programme of the European Union



- Intro: The Rise of Big Data
- Research Solution: Project DICE
- DICE Meta-models
- M2M and TOSCA in DICE

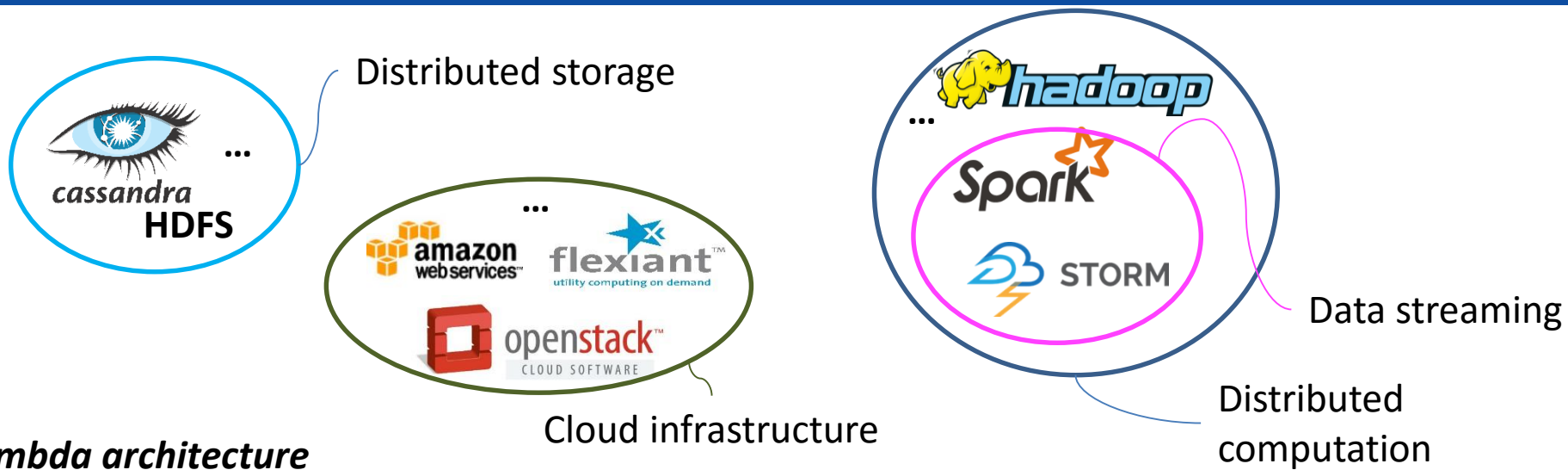
# Intro: The Rise of Big Data



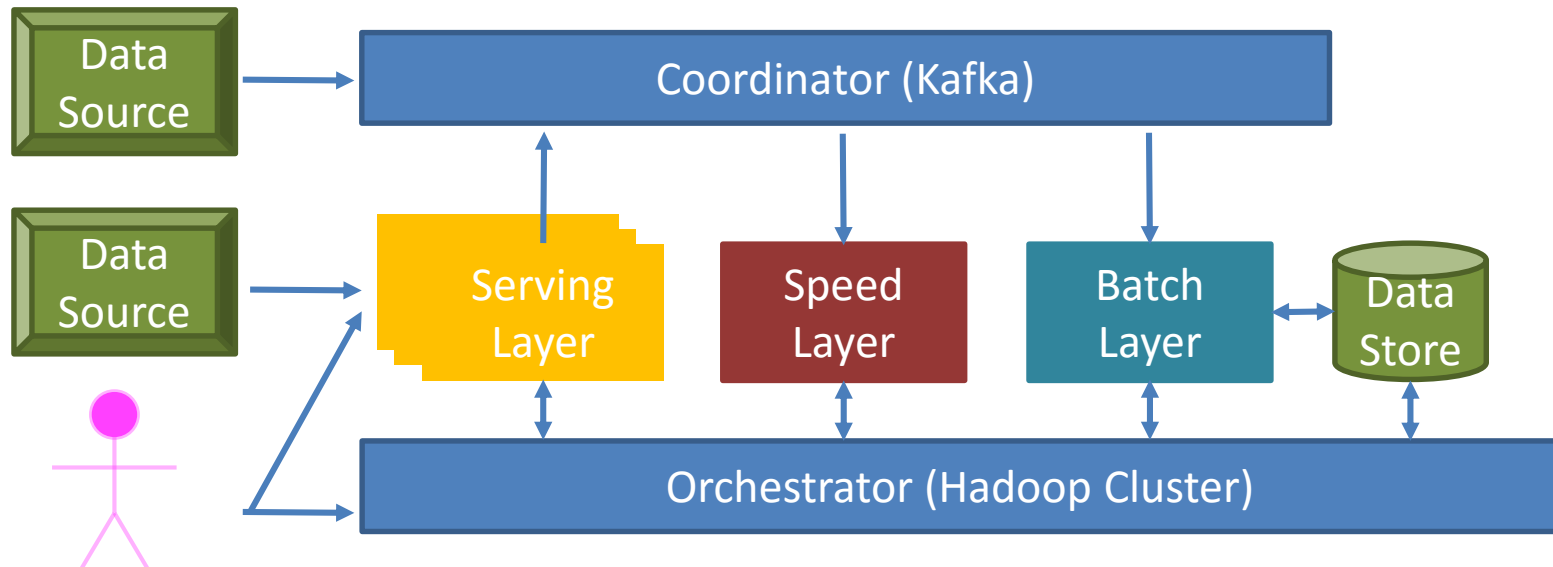
- Software market rapidly shifting to Big data
  - Expected 32% compound annual growth rate in EU through 2016
  - Just 35% of Big data projects are successful [CapGemini'15]



# Intro: Building blocks for DIAs today



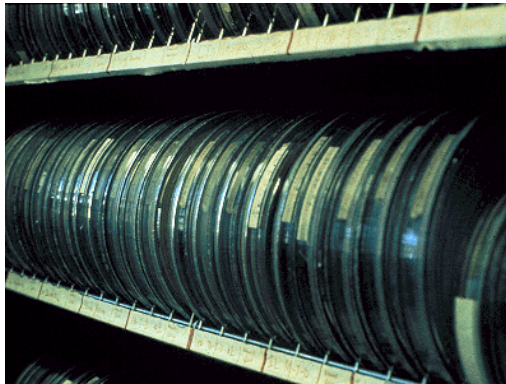
## *Lambda architecture*



# Intro: example challenges!



## Legacy Systems and Processes



Learning curves



Initial prototype



Risk of failure



## Big Data Analytics Adoption



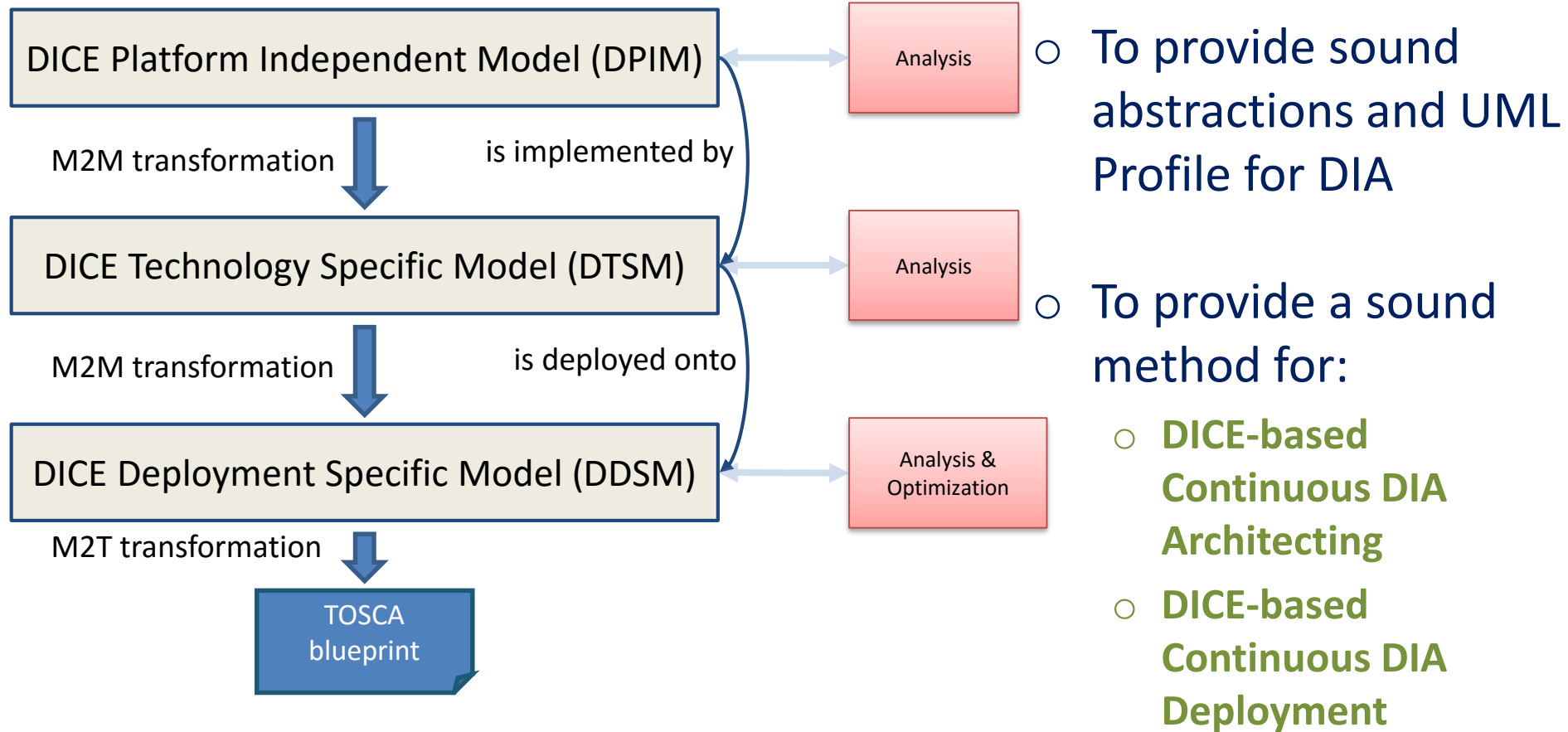
# DICE Objectives



- Tackling skill shortage and steep learning curves
  - High-degree of MDE automation via DICE tools
- Shorten time to market for DIAs
  - Push out new products, without sacrificing quality
- Decrease development and testing costs
  - Fast iterative definition of application prototypes
- Reduce number and severity of quality incidents
  - DevOps-fashion Iterative refinement of application design

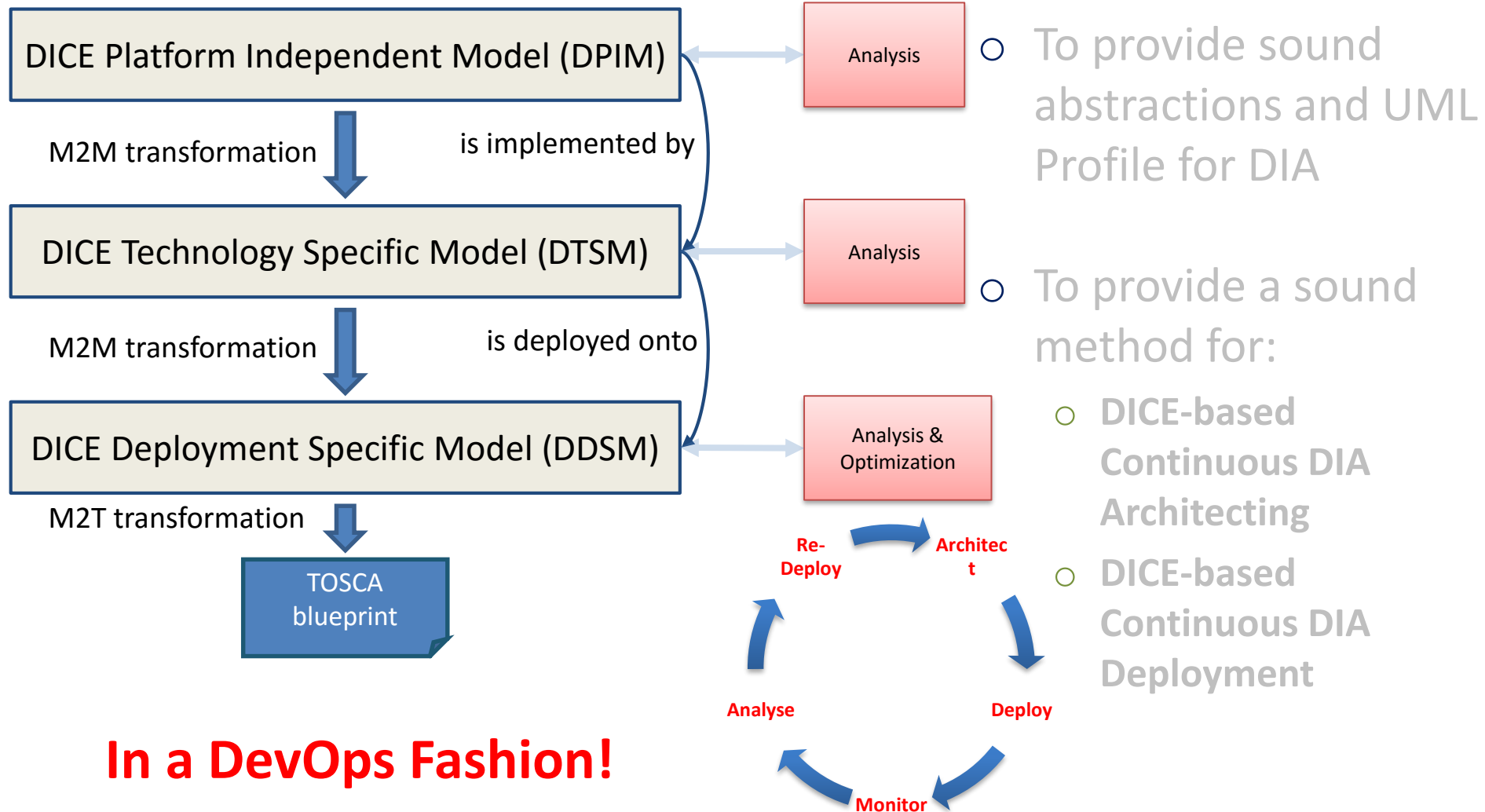


# DICE incremental modeling and analysis<sup>[6]</sup>





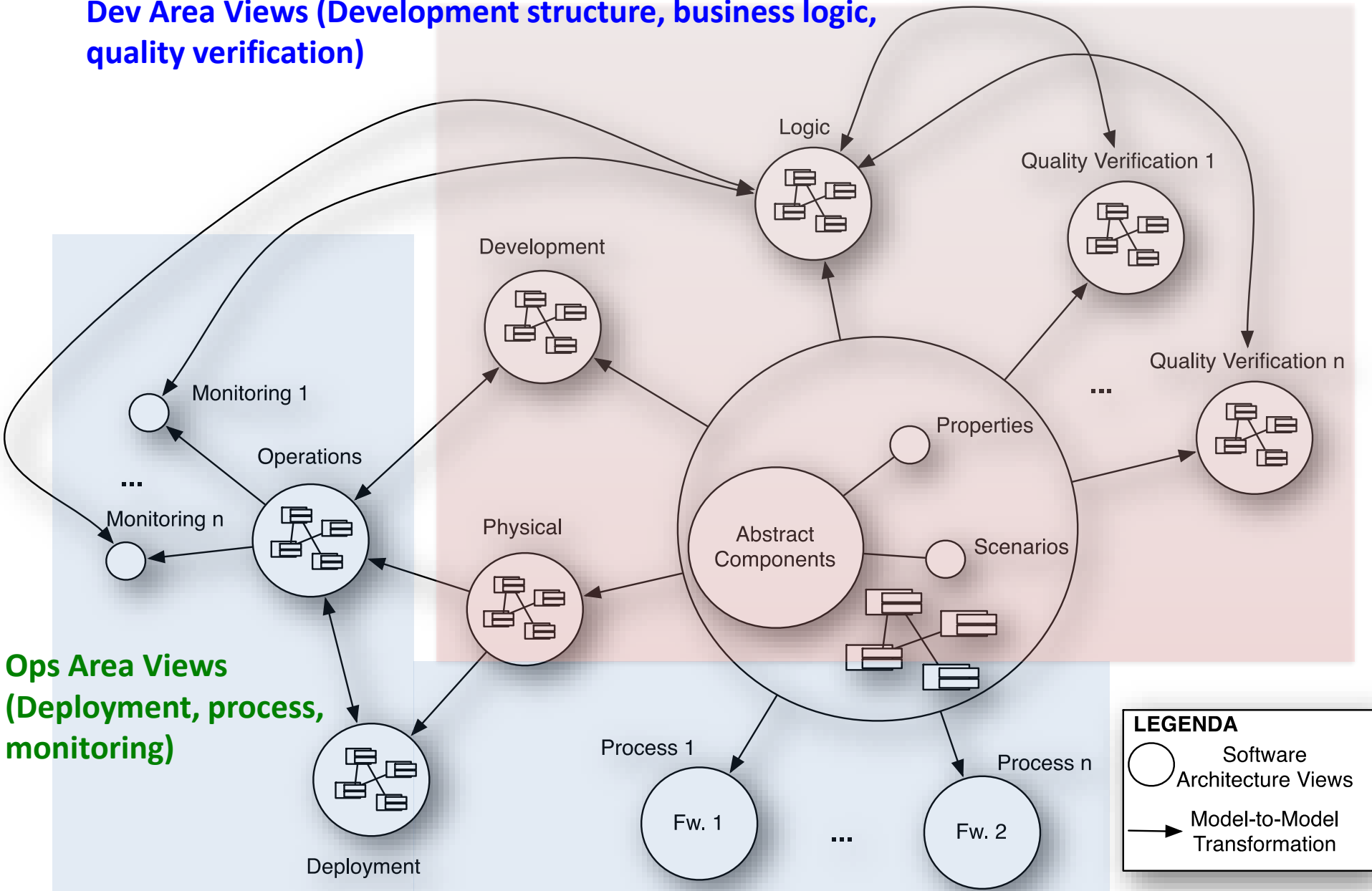
# DICE incremental modeling and analysis<sup>[6]</sup>



# Where does this come from?



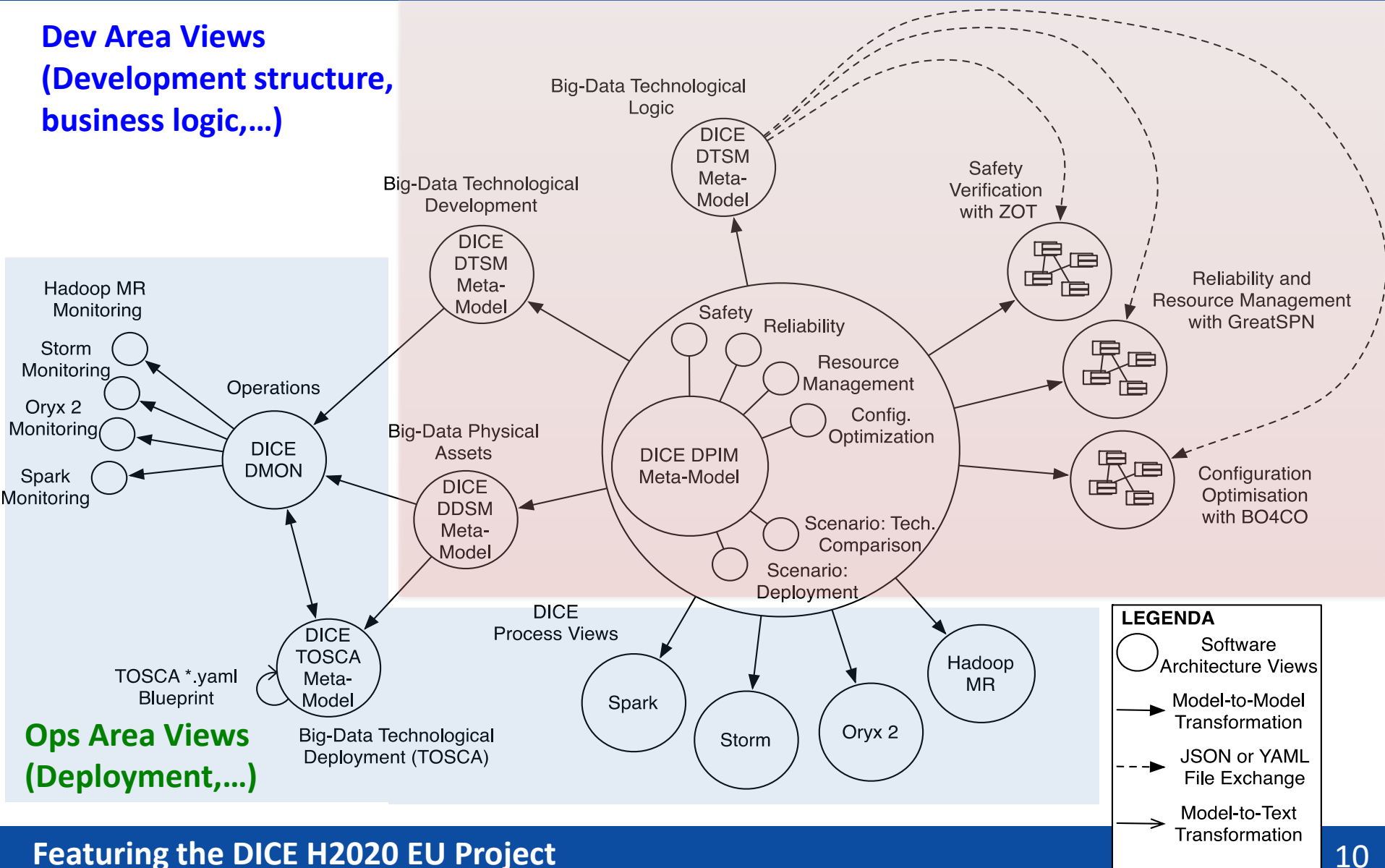
**Dev Area Views (Development structure, business logic, quality verification)**



# Where does this come from? DICE!



## Dev Area Views (Development structure, business logic,...)



## Ops Area Views (Deployment,...)

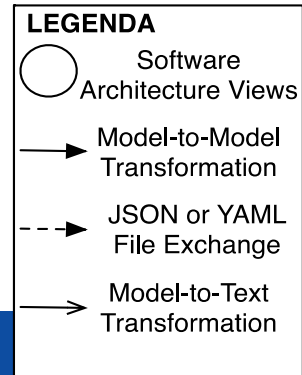


The diagram illustrates the DICE Architecture. At the center is a node labeled "DICE DMON". Four main branches radiate from this central node:

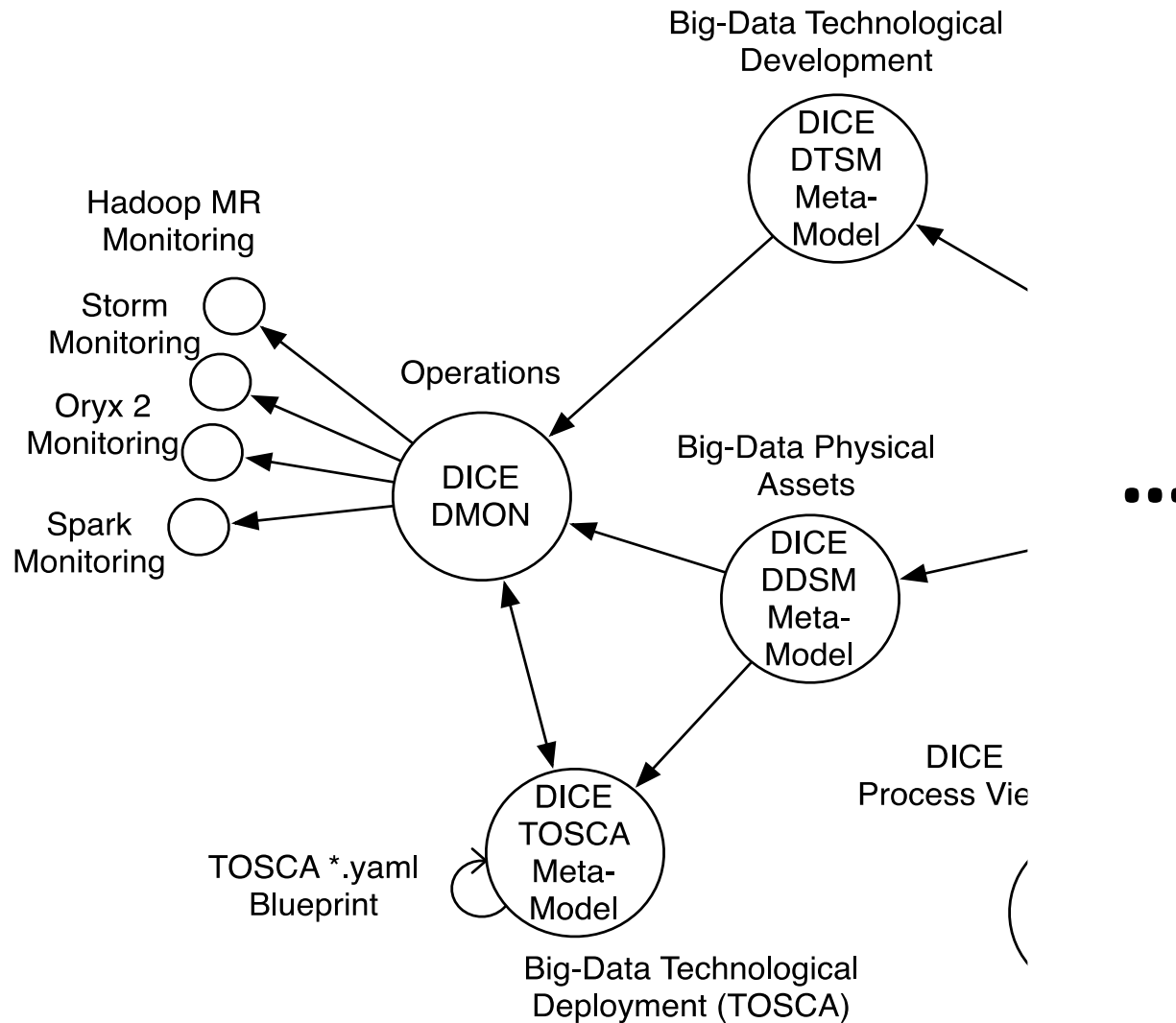
- Operations:** This branch connects to four monitoring nodes: "Hadoop MR Monitoring", "Storm Monitoring", "Oryx 2 Monitoring", and "Spark Monitoring".
- Big-Data Technological Development:** This branch connects to the "DICE DTSM Meta-Model".
- Big-Data Physical Assets:** This branch connects to the "DICE DDSM Meta-Model".
- Big-Data Technological Deployment (TOSCA):** This branch connects to the "DICE TOSCA Meta-Model".

Additional details include:

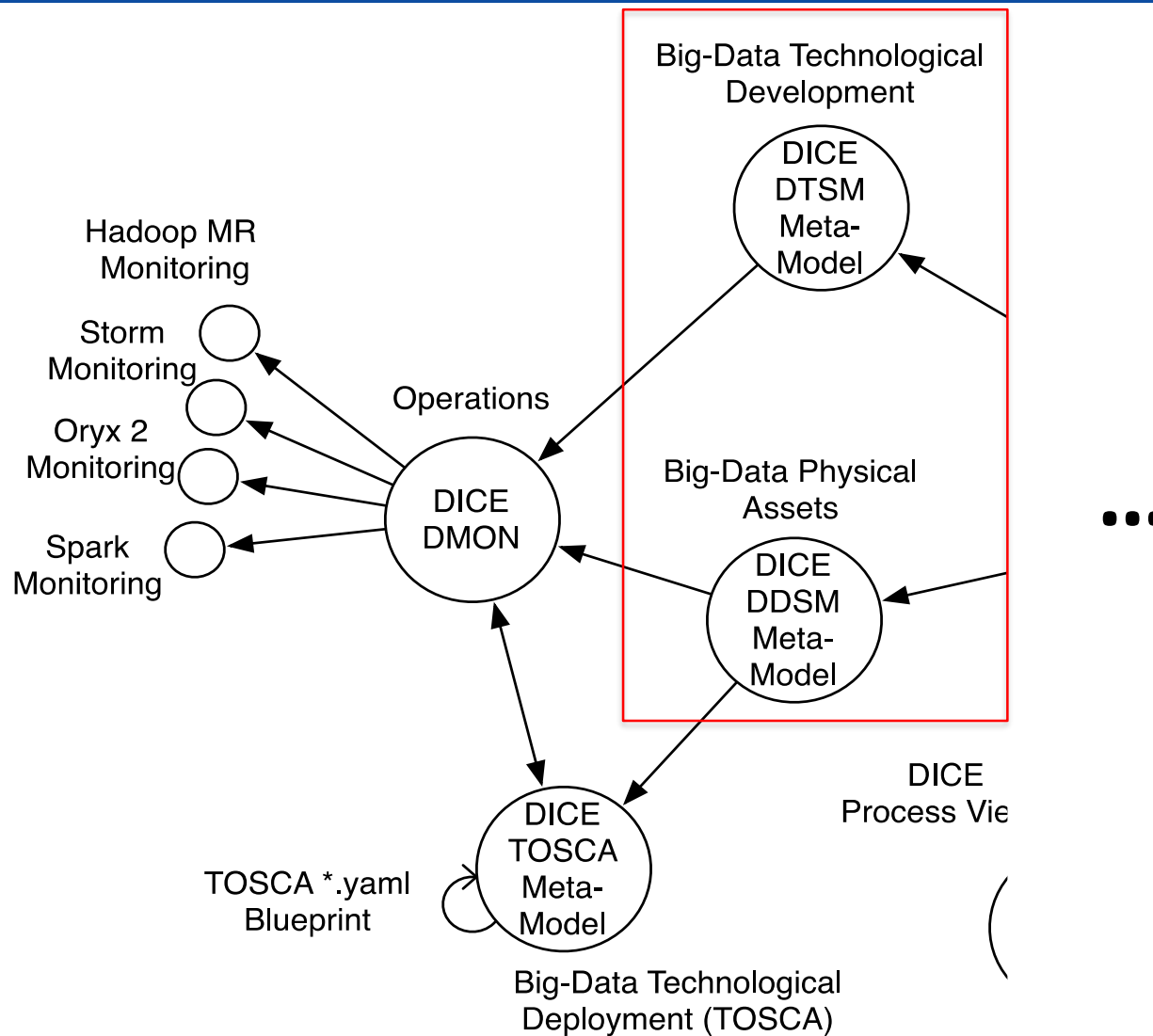
- A self-loop arrow on the "DICE TOSCA Meta-Model" node, labeled "TOSCA \*.yaml Blueprint".
- Arrows indicate the direction of data flow between the central "DICE DMON" and the various meta-models and monitoring components.



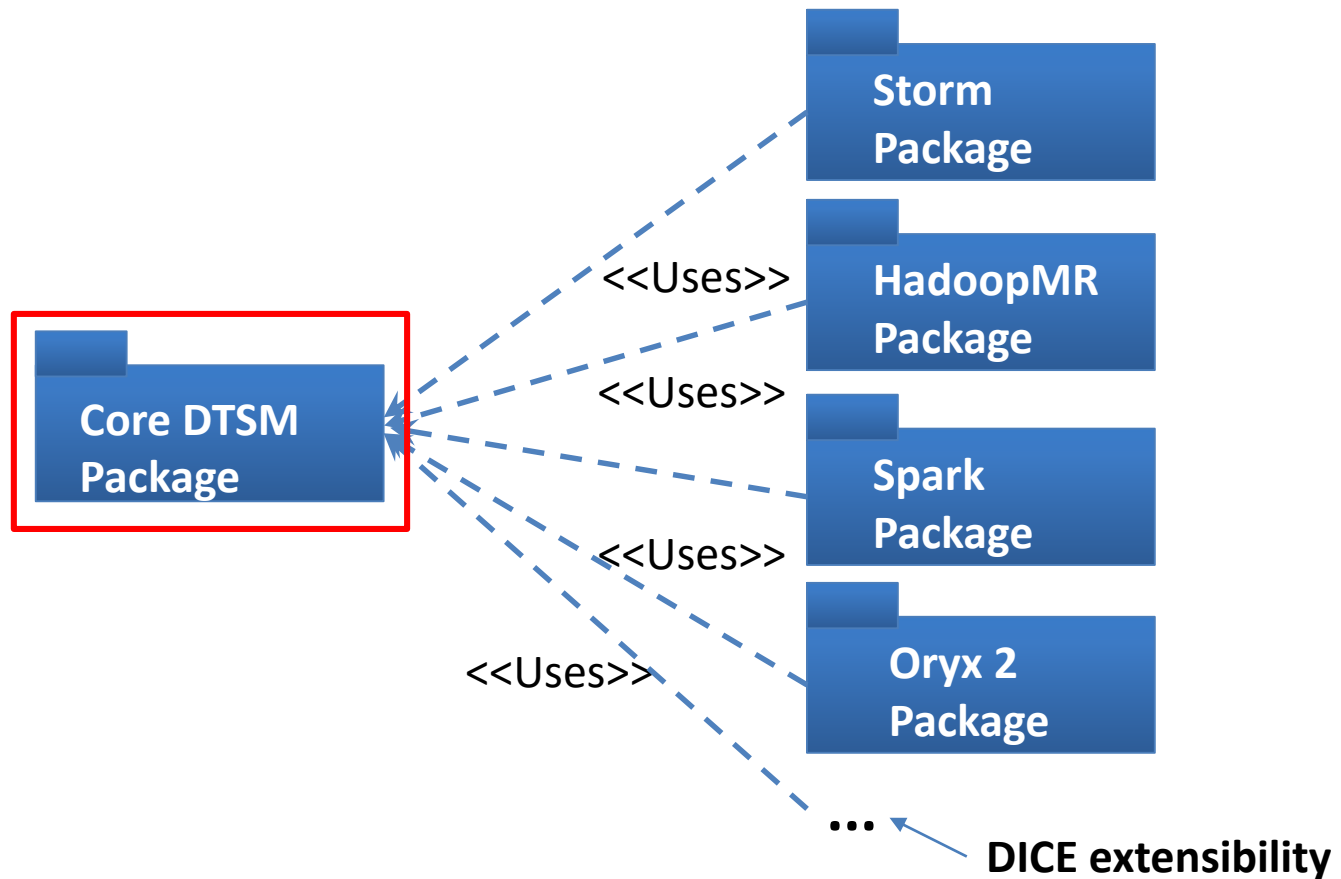
# Where does this come from? DICE!



# Where does this come from? DICE!



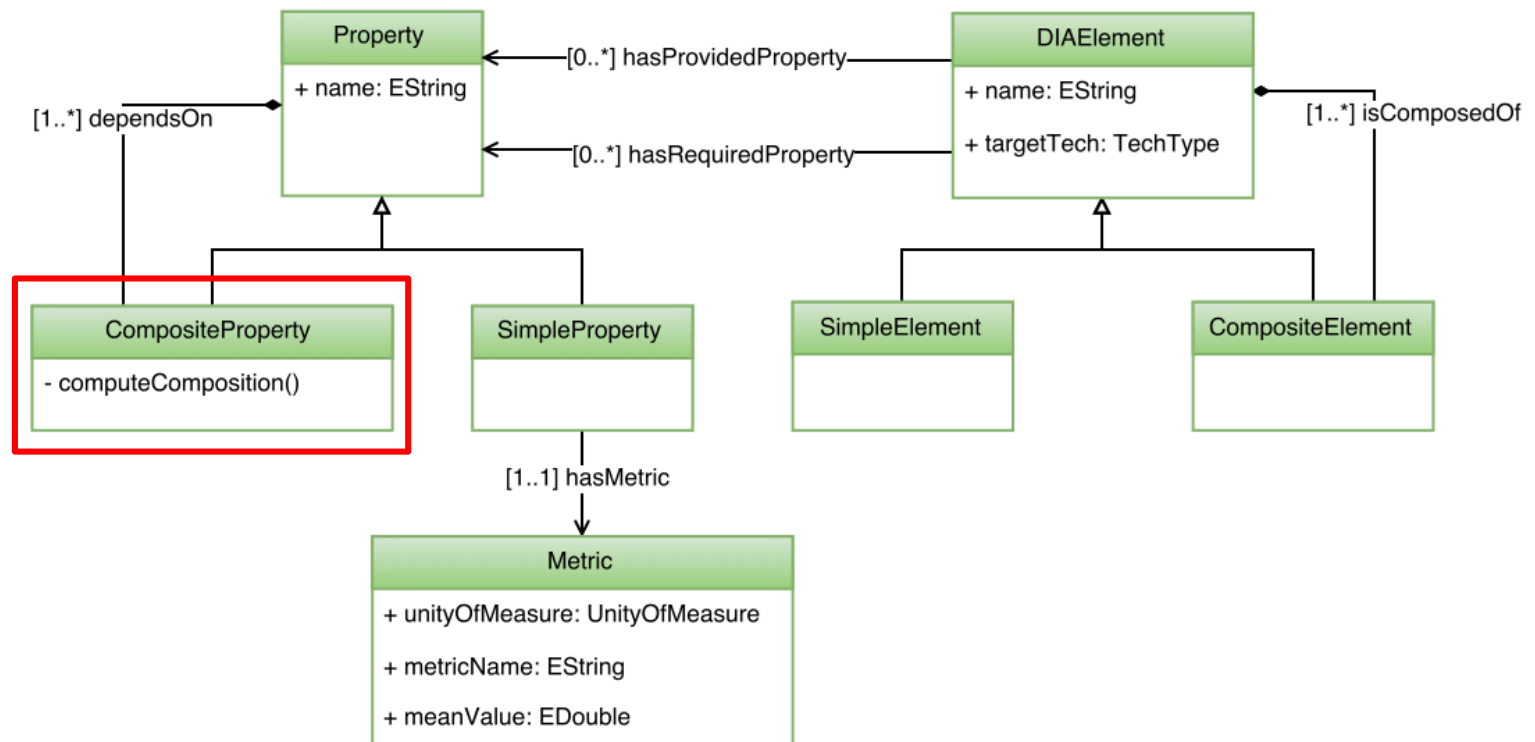
# DICE Meta-models - DTSM



# DICE Meta-models\* - DTSM Core



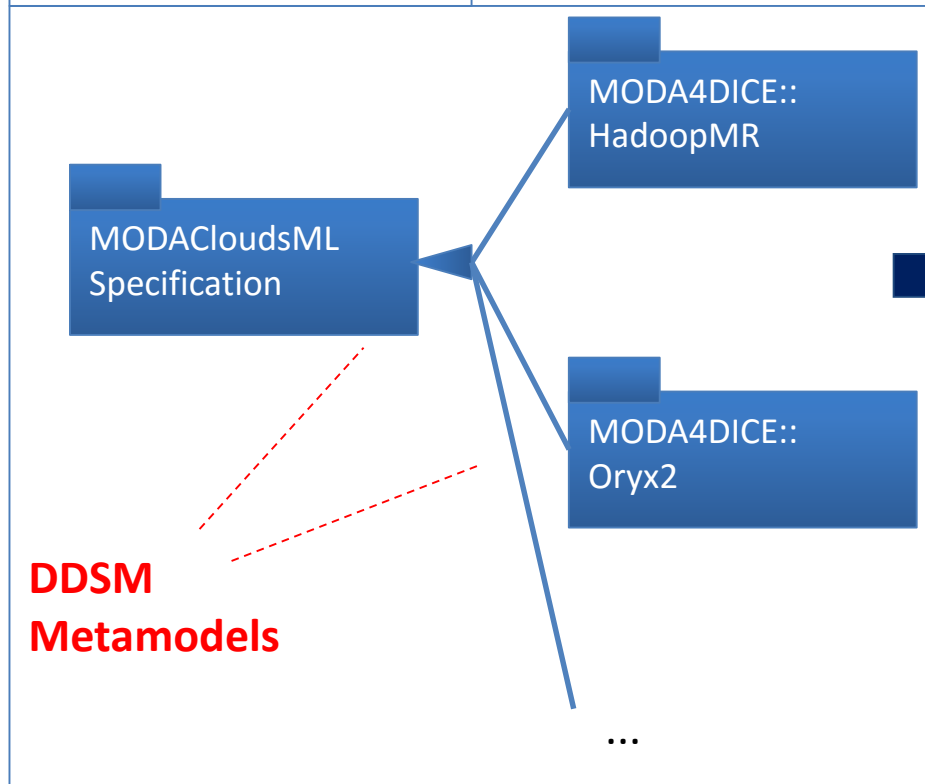
1. Common to all DICE tech-packs;
2. Distinguishing analysable elements;
3. Distinguishing properties;
4. Simplified property definition;



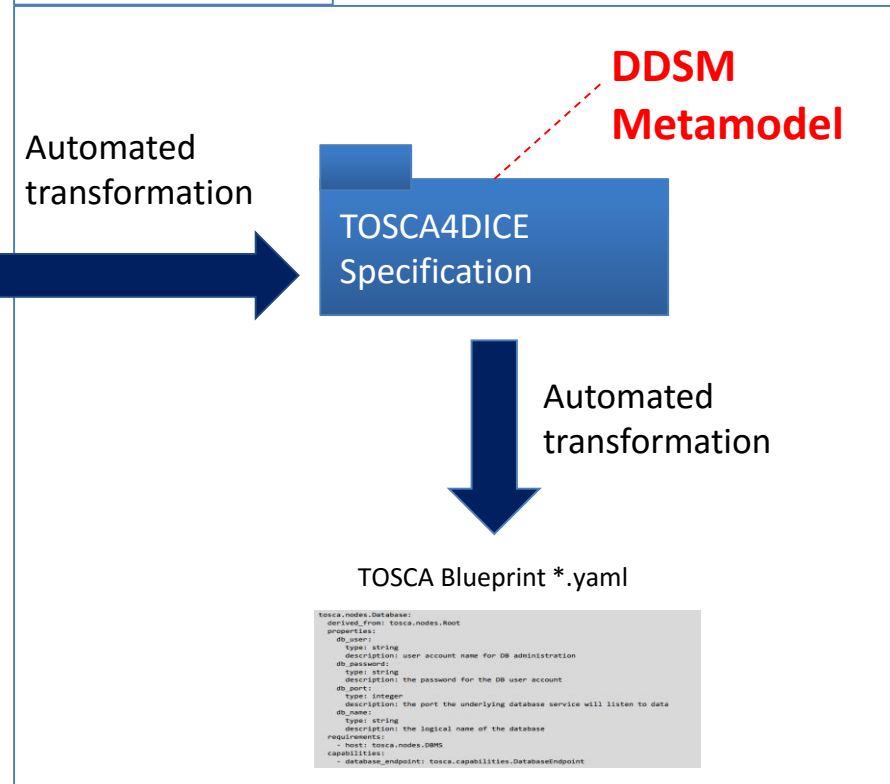
# DICE Meta-models – DDSM<sup>[5]</sup>



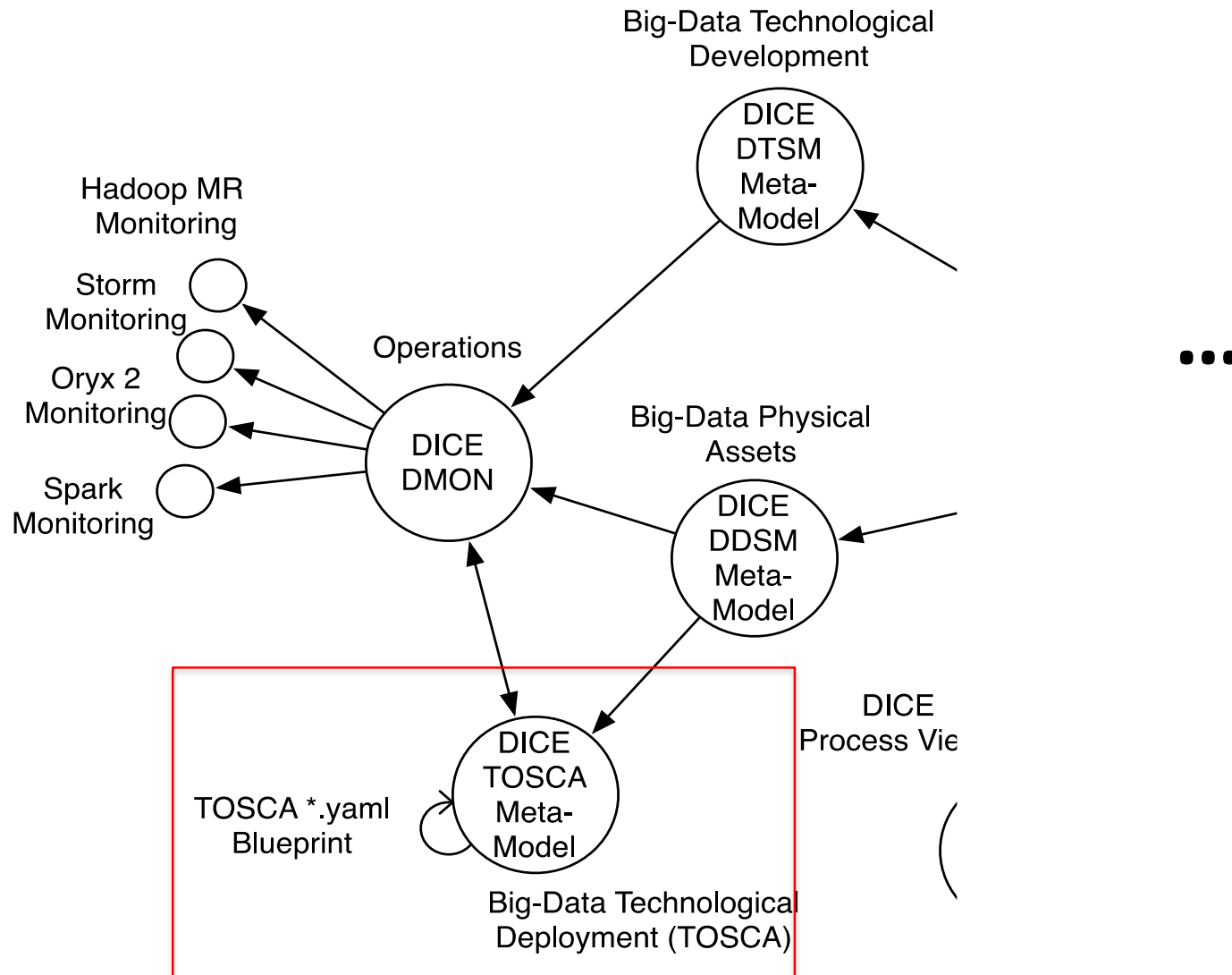
## MODACloudsML4DICE



## DICER M2T Tool



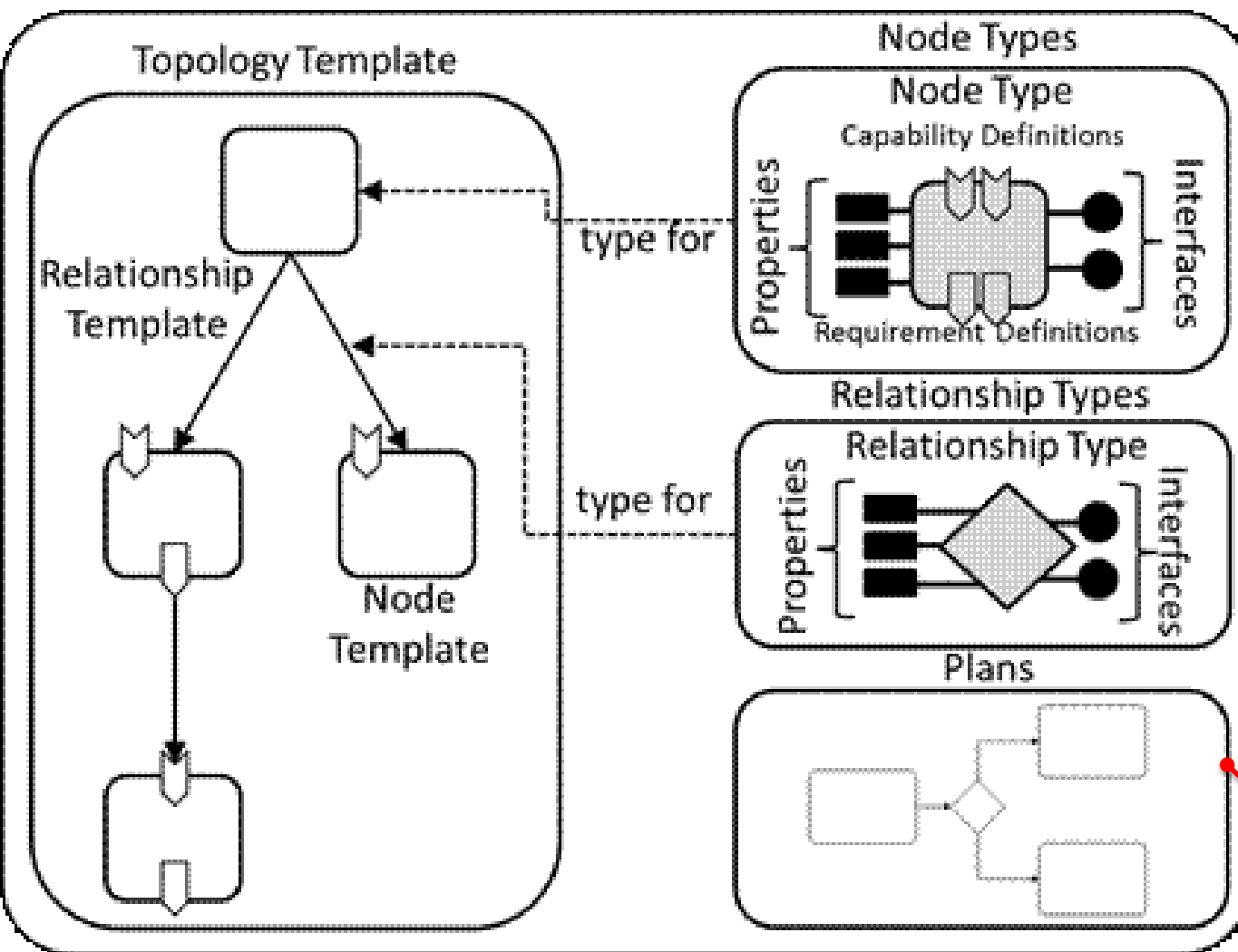
# Where does this come from? DICE!



# DICE Meta-models – DDSM TOSCA



## “Topology and Orchestration Specification for Cloud Applications”



1. OASIS Standard;
2. Cloud Infrastructure-as-code language;
1. Type-strength Intent modeling;
2. In DICE? Big-Data TOSCA “profile”;

Service template

# DICE Meta-models – DDSM TOSCA

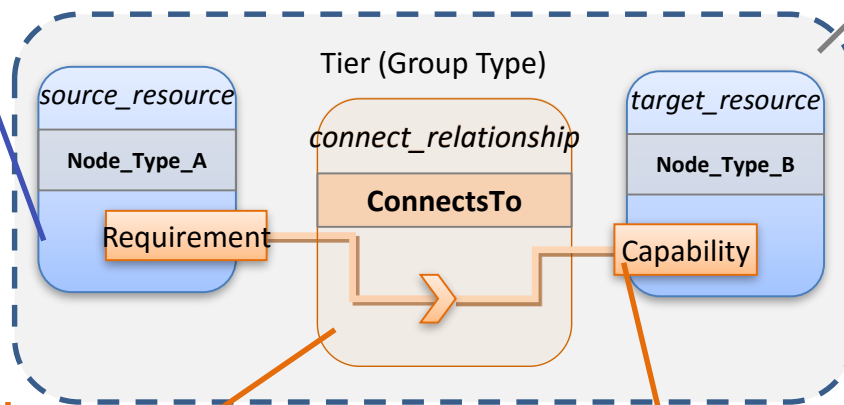


“TOSCA is used to describe the **deployment view** for cloud applications”

- ✓ **Node templates** to describe components in the topology structure
- ✓ **Relationship templates** to describe connections, dependencies, deployment ordering

**Nodes** - are the resources or components that will be materialized or consumed in the deployment topology

**Groups**  
Create Logical, Management or Policy groups (1 or more nodes)



**Relationships**  
express the dependencies between the nodes (not the traffic flow)

**Requirement - Capability**  
Relationships can be customized to match specific source requirements to target capabilities

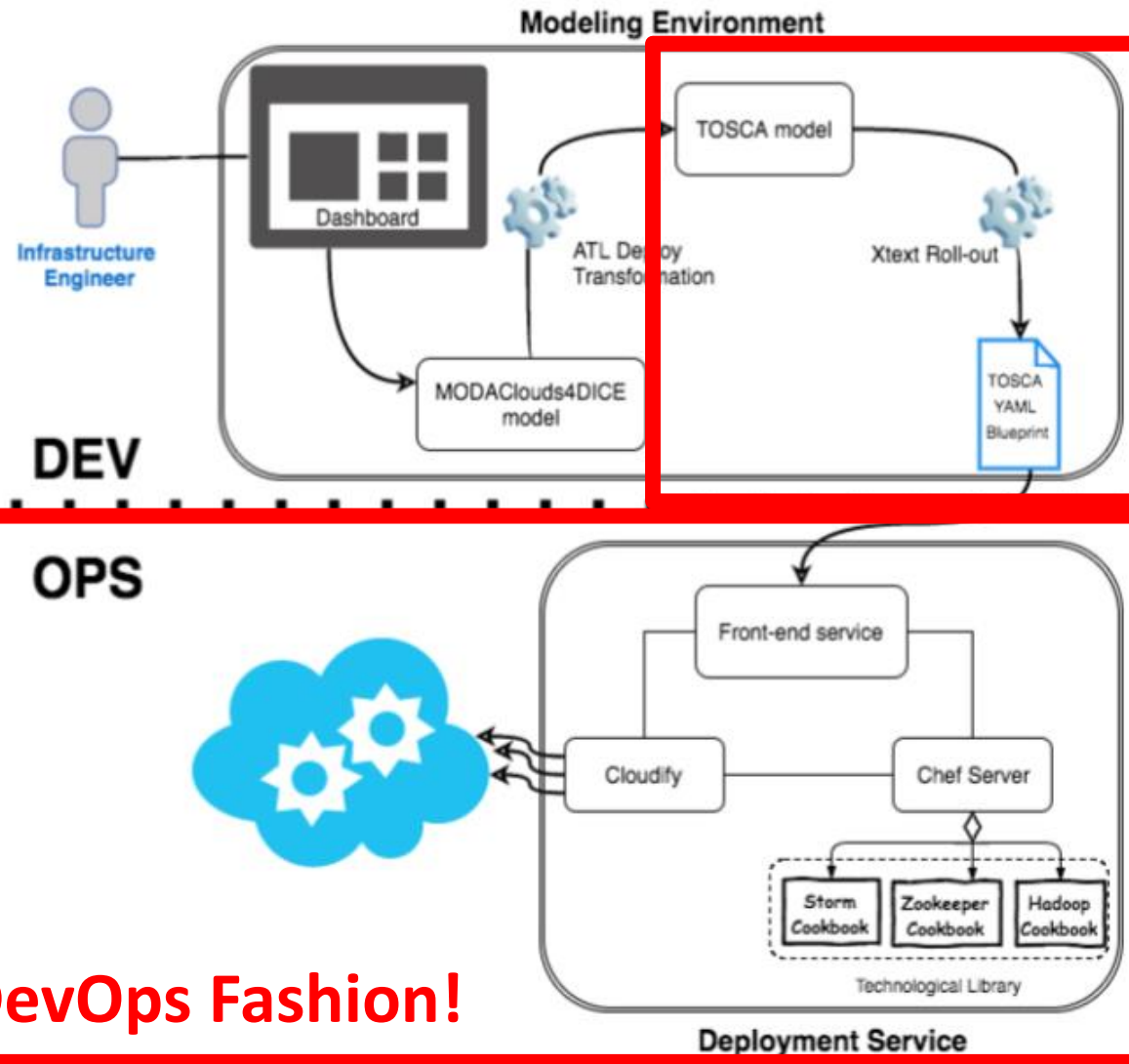
# With M2M a TOSCA blueprint happens!



```
.....  
"storm_nimbus_host": {  
  "relationships": [  
    {  
      "type": "cloudify.openstack.server_connected_to_floating_ip",  
      "target": "storm_floating_ip"  
    },  
    {  
      "type": "cloudify.openstack.server_connected_to_security_group",  
      "target": "storm_security_group"  
    }  
  ],  
  "type": "dice.medium_host"  
},
```

```
"zookeeper": {  
  "relationships": [  
    {  
      "type": "cloudify.relationships.contained_in",  
      "target": "zookeeper_host",  
      "source_interfaces": {  
        "cloudify.interfaces.relationship_lifecycle": {  
          "preconfigure": "scripts/connect_zookeeper_servers.sh"  
        }  
      }  
    }  
  ],  
  "type": "dice.medium_host"  
},  
.....
```

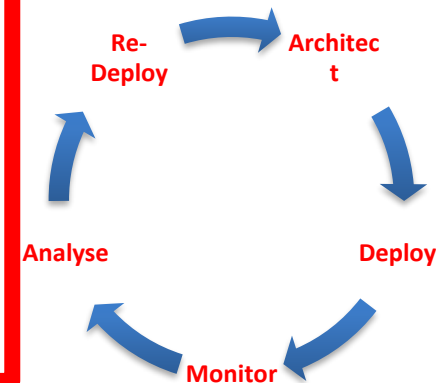
# And after that... DevOps!



**TOSCA!**



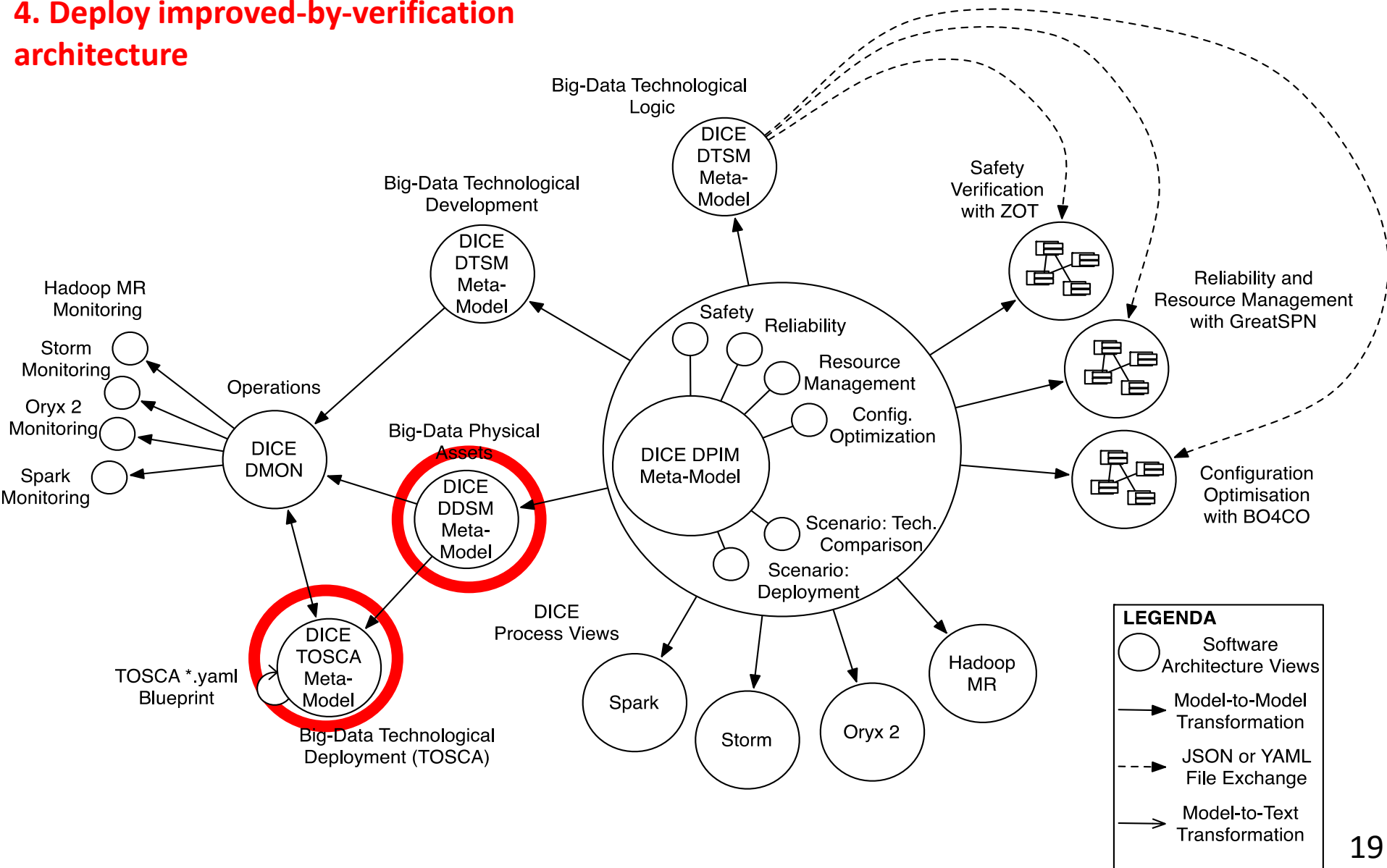
**TOSCA Deployment!**





# Back to basics... DICE Views and Tools!

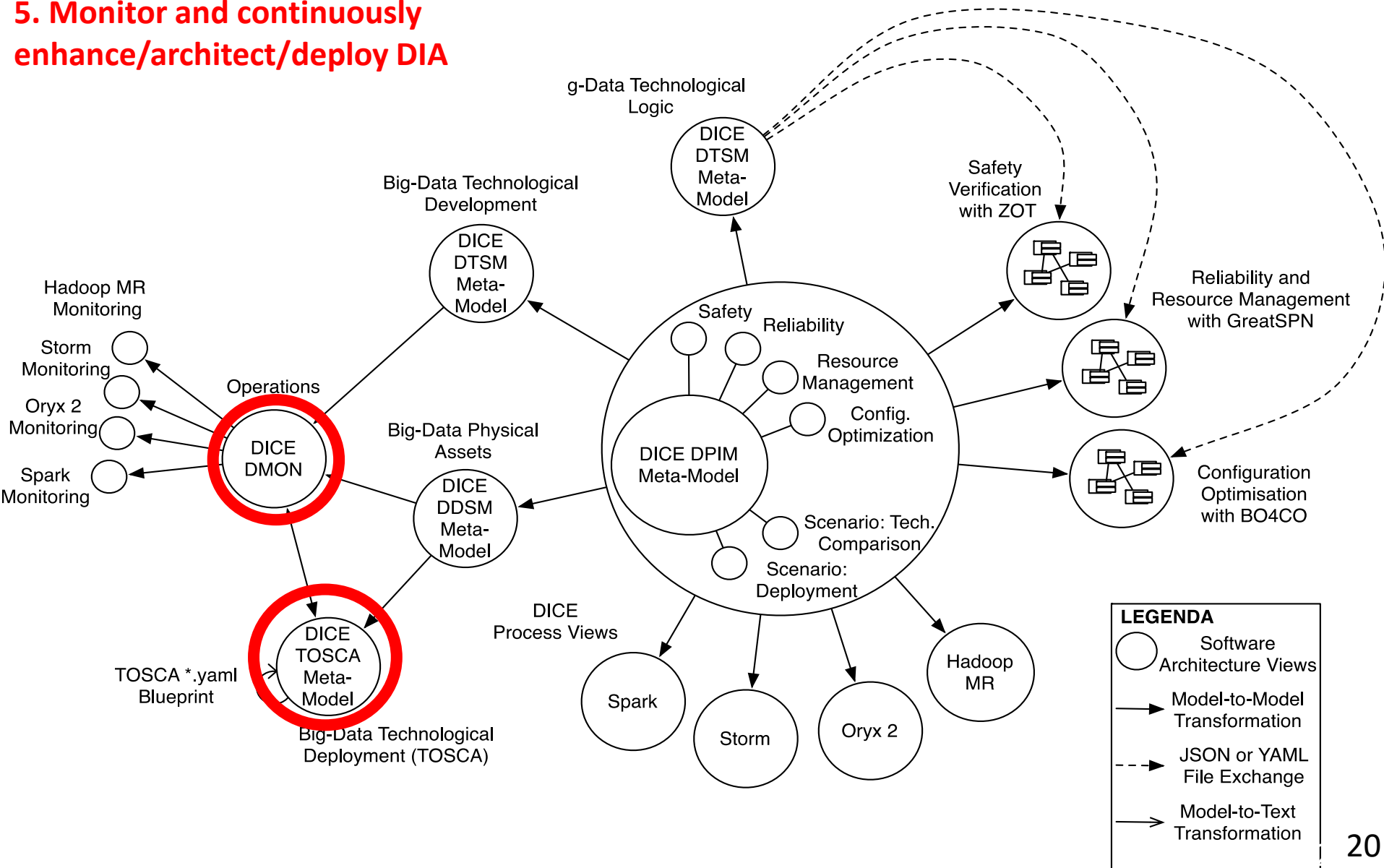
## 4. Deploy improved-by-verification architecture





# Back to basics... DICE Views and Tools!

## 5. Monitor and continuously enhance/architect/deploy DIA





- **MDE+TOSCA = DevOps Synergy!**
- Big-Data and TOSCA are fit for each other...
  - **but technologies are not mature, yet!**



- [1] A. Rajbhoj, V. Kulkarni, and N. Bellarykar. Early experience with model-driven development of mapreduce based big data application. In Software Engineering Conference (APSEC), 2014 21st Asia-Pacific, volume 1, pages 94–97, Dec 2014.
- [2] S. Santurkar, A. Arora, and K. Chandrasekaran. Stormgen - a domain specific language to create ad-hoc storm topologies. In Computer Science and Information Systems (FedCSIS), 2014 Federated Conference on, pages 1621–1628, Sept 2014.
- [3] Abel Gómez, José Merseguer, Elisabetta Di Nitto, Damian A. Tamburri “Towards a UML Profile for Data Intensive Applications”, Proceedings of 2<sup>nd</sup> “Quality Aware DevOps” (QUDOS) workshop, to appear
- [4] Elisabetta Di Nitto, Pooyan Jamshidi, Michele Guerriero, Ilias Spais, Damian A. Tamburri “A Software Architecture Framework for Quality-Aware DevOps”, Proceedings of 2<sup>nd</sup> “Quality Aware DevOps” (QUDOS) workshop, to appear
- [5] Matej Artac̆, Tadej Borovšak, Elisabetta Di Nitto, Michele Guerriero, Damian A. Tamburri, “Model-Driven Continuous Deployment for Quality DevOps”, Proceedings of 2<sup>nd</sup> “Quality Aware DevOps” (QUDOS) workshop, to appear
- [6] Guerriero, Michele; Tajfar, Saeed; Tamburri, Damian A. & Di Nitto, Elisabetta (2016), “Towards a model-driven design tool for big data architectures.”, in 'BIGDSE@ICSE' , ACM, , pp. 37-43 .