**Deep modelling.**

*Research papers summary.*

1. **Colin Atkinson. Meta-level Independent Modelling**  
   UML is overloaded with a number or redundant concepts regarding modelling level interaction. In other words, on each level of modelling different approaches of instantiation are used (example, from M1 to M0 instantiation the ‘instance-of’ relation is used whereas from M2 to M1 the stereotype concept is utilized).  
   **Goal:** This paper attempts to specify a uniform format of instantiation regardless of its level in UML.  
   **Techniques:** Introduced 2 fundamental properties of meta-modelling. Specified and described the notion of clabjects.  
   **Results:** Presented a way to represent clabjects in terms of Generalized UML. Claims that in order to get rid of the current confusions in UML, it should be based on level-independent modelling techniques.
2. **Colin Atkinson. The Essence of Multilevel Metamodeling**  
   **Goal:** This paper emphasizes the limitations of UML in terms of its shallow instantiation mechanisms and its inability to treat an object both as an instance and a class. Pinpoint the limitations of the UML instantiation mechanisms as well as its ambiguous classification. Provide techniques to overcome the aforementioned problems.  
   **Techniques:** The problem of shallow instantiation is described (if an element is instantiated then in a classical UML all its attributes become slots as well as all its associations become links which makes it impossible to model across more than one level without introducing of extra components in the metamodel). Provided and compared known techniques to deal with the shallow instantiation problem.  
   **Results:** Introduced the ‘Deep Instantiation’ concept as well as the notion of ‘potency’ (potency is an integer value that shows a depth to which a certain model element can be instantiated). Introduced an M3 model for modelling multiple meta-levels.
3. **Colin Atkinson. Rearchitecting the UML infrastructure**  
   **Goal:** This paper server mostly as a summary of both (1) and (2) papers. It points out three main limitations of metamodeling frameworks, namely: dual classification (specify both physical and logical concepts), class/object duality (instance is an object but also has class traits), replication of concepts (some concepts must be repeated several times). After that, the potential approach to overcome those problems are presented.  
     
   **Dual classification** in UML might be explained as follows: logical domain classifiers server to show that a certain instance is an actual instance of a certain domain type – thus, logical instantiation (Product type -> Book -> The Star Wars). On the other hand, it’s important to emphasize that an instance is actually an object that has slots and links or a fragment is a class that has attributes and associations - thus, physical instantiation where these facts should be defined (Book -> Class; The Star Wars -> Object).  
   **Techniques:**  
   To deal with dual classification the paper provides several existing approaches to tackle this limitation like ‘prototypical concepts’ (prioritize logical facet), ‘metamodels as language definitions’ (prioritize physical face), ‘non-linear frameworks’ (facet of an instance depends on a context which can be switched).  
   Dealing with **replication of concepts** can be achieved by using the notion of ‘potency’.   
   **Results:**  
   Three potential approaches are collected and described for a new rearchitected UML to tackle the current problems of 4-level metamodeling frameworks.