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Visual Change Tracking for Business Process Models

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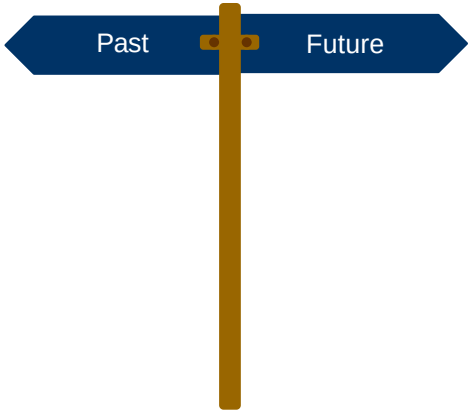
AGENDA

- CONTEXT

  Visualization of change in Business Process Models

- POSSIBLE SOLUTION

  Change Tracking Graph with two intuitive layouts



- SURVEY

  to elicit users' preferences of the change tracking graph layouting

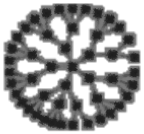
Motivation

- Different Graph drawing /layout approaches exist , e.g.:
  - Trees

Herman, I., Melancon, G., Marshall, M.S.: Graph Visualization and Navigation in Information Visualization: A Survey. IEEE Transactions on Visualization and Computer Graphics, 6/1, Jan (2000)

  - Spring

  - Radial



Diehl, S., Goerg, C., Kerren, A.: Preserving the mental map using foresighted layout. In: Proc. of Joint Eurographics IEEE TCVG Symposium on Visualization. pp. 175-184. Springer (2001)

➡ most of the works on graph drawing **concentrate on single static graphs**, visual representation of graphs which can **change over time have received little attention** (e.g. Diehl et al 2001)**.**

Research Issues

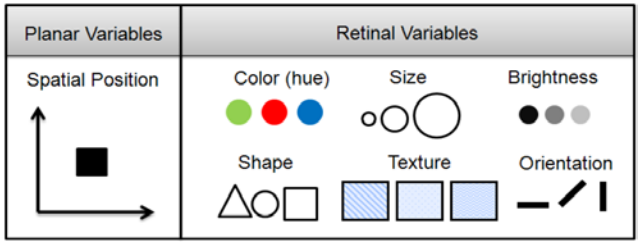
- How to consider change as content in graphs?

Nothing is really deleted

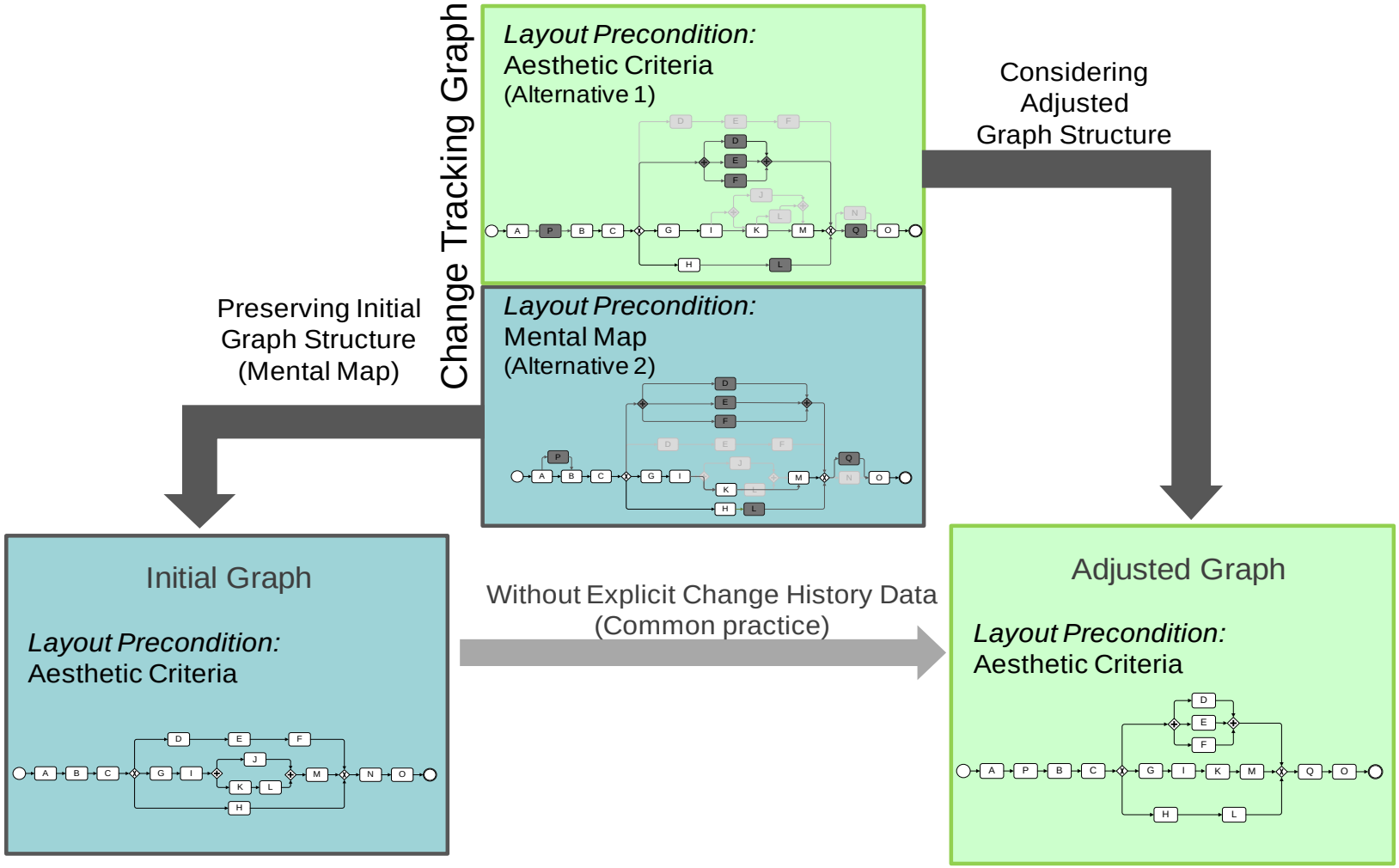
- How to layout change tracking graphs?

Past | Future

- How to visualize change in the change tracking graph?



Change Tracking Graph - Overview



Change Tracking Graph - Overview

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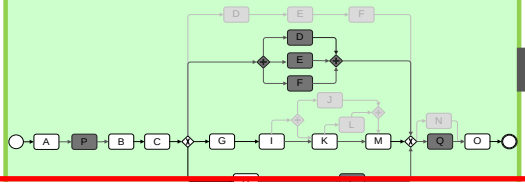
Tracking Graph

Layout Precondition:
Aesthetic Criteria
(Alternative 1)

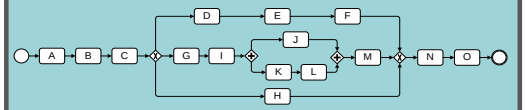


Considering
Adjusted
Graph Structure

Precondition 1: There already exists an initial graph A.
Precondition 2: The initial graph A corresponds to certain quality metrics.
Precondition 3: Change that needs to be performed on the initial graph A is predefined by means of a sequence of change patterns.

Initial Graph

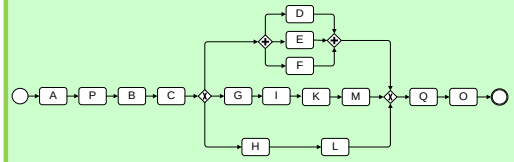
Layout Precondition:
Aesthetic Criteria



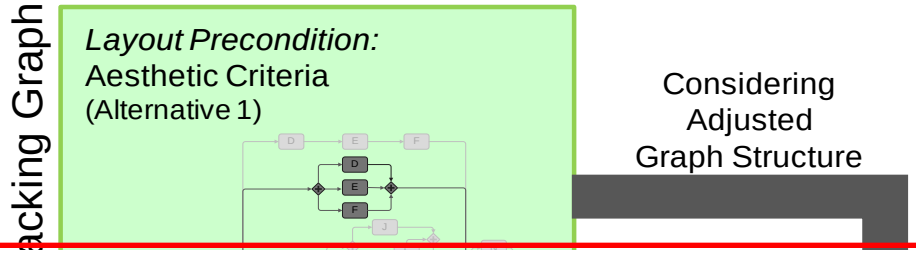
Without Explicit Change History Data
(Common practice)

Adjusted Graph

Layout Precondition:
Aesthetic Criteria



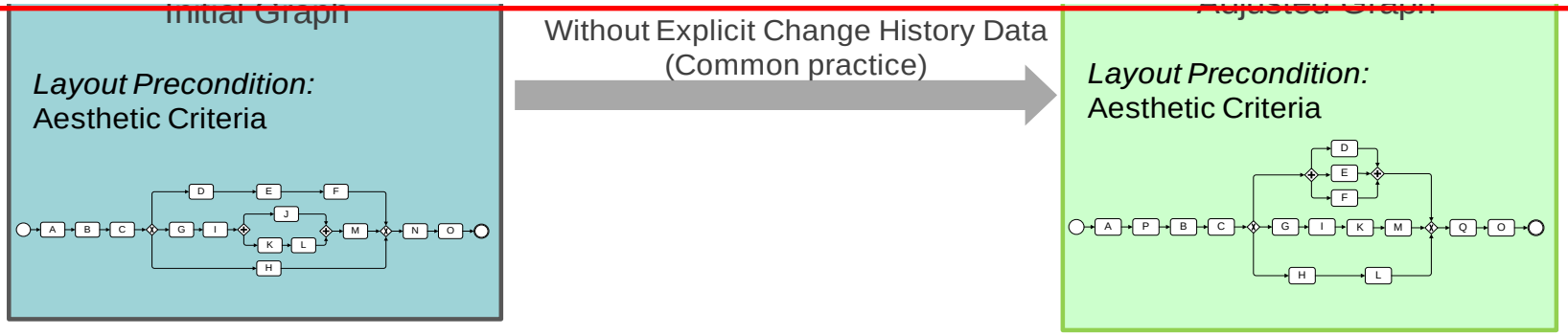
Change Tracking Graph - Overview



Postcondition 1: There are three graphs available, the initial graph A, the change tracking graph A^*, and the adjusted graph A'.

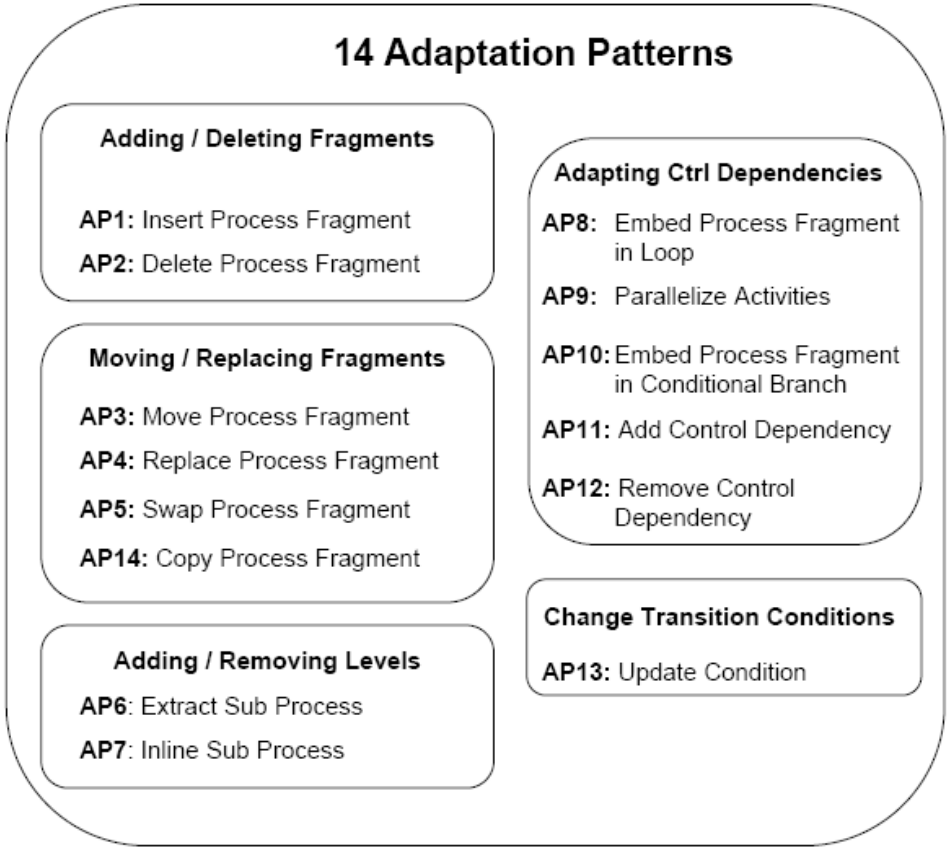
Postcondition 2: The graph A^* is designed according to two layouts. A^*_{MM} considers the layout of the initial graph A. A^*_{AC} considers the layout of the adjusted graph A'.

Postcondition 3: The graph A' correspond to certain quality metrics.



Process Change

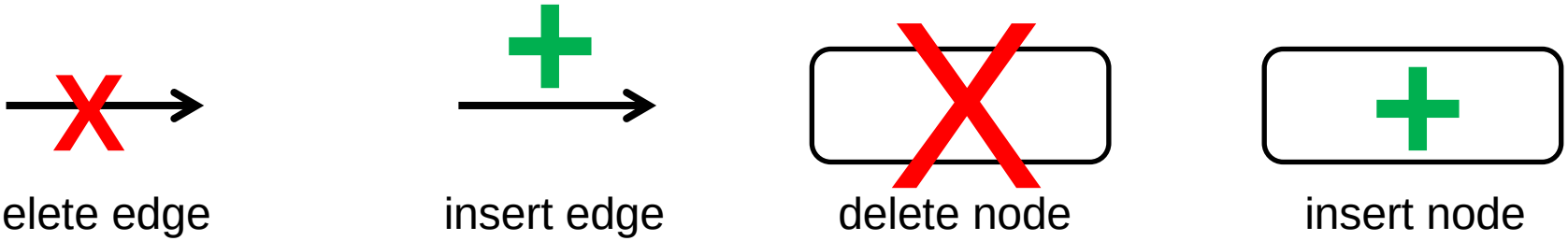
For our approach we assume that change is to be conducted to an already existing graph by following a predefined set of change patterns at a specific date.



Weber, B., Reichert, M., Rinderle-Ma, S.: Change patterns and change support features - enhancing flexibility in process-aware information systems. Data Knowl. Eng. 66, 438-466 (2008), part of Fig. 5, p. 12

Change Primitives

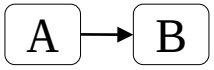
- Expression of all kinds of change patterns by the following change primitives:



- *Add* and *delete* allows to easily mark the change with particular visual properties without challenging the graph user with an exaggerated number of new visual appearance of the graph elements.

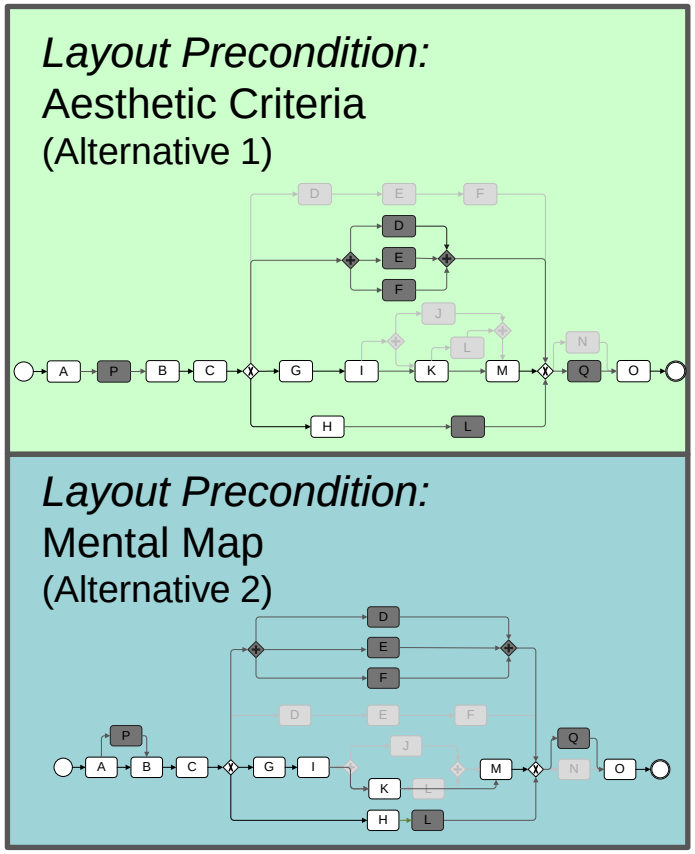
serialMove Replace Swap Parallelize

Examples

Initial Model A	Change to be implemented: Change Pattern & Textual Description	Change to be implemented: Formal Change Tracking	Adjusted Model A'
	*Serial Insert* (S,X,A,B) *Insert X between the Nodes A and B*	serial_insert (S,X,A,B) = <deleteEdge (S,A,B), insertNode (S,X), insertEdge (S,A,X), insertEdge (S,X,B) >	
	*Replace (S,B,X)* *Replace Node B by Node X*	replace (S,B,X) = <deleteEdge (S,A,B), deleteEdge (S,B,C), deleteNode (S,B), insertNode (S,X), insertEdge (S,A,X), insertEdge (S,X,C)>	

Graph Elements

Change Tracking Graph



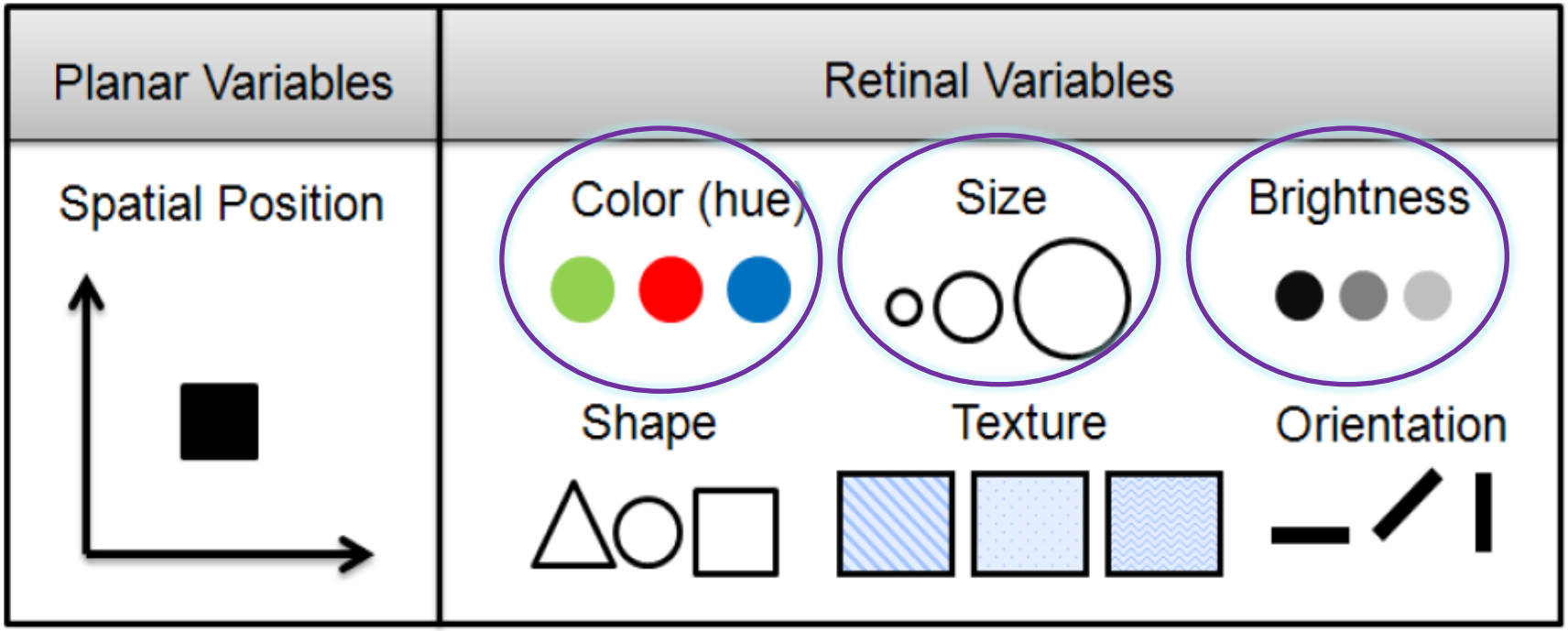
- Transformation of the initial graph A to the adjusted graph A'.
- The Change Tracking Graph A* contains graph elements:

= of A that are not affected by change

X of A that are deleted

\+ that are added during change

Visual Properties



Kriglstein, S.: Human Centered Visualization of Ontologies (Doctoral thesis). (2011)

Based on: Card, S., Mackinlay, J. D., & Shneiderman, B. (1999). Readings in Information Visualization: Using Vision to Think: Morgan Kaufmann. and North, C. (2005). Information Visualization. In G. Salvendy (Ed.), Handbook of Human Factors and Ergonomics (3rd ed.), pp. 1222 - 1246: John Wiley & Sons.

Example - Swap A,B with F

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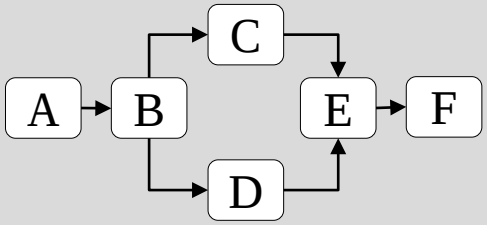
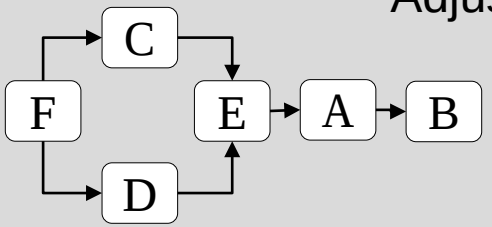
Initial Graph A

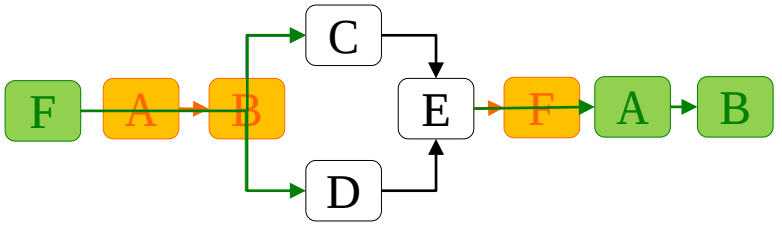


Adjusted Graph A'

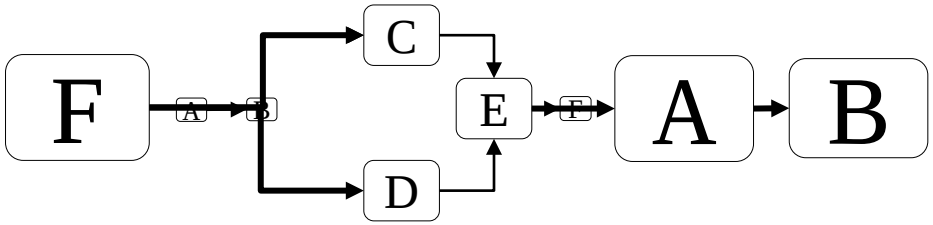


VISUAL PROPERTIES

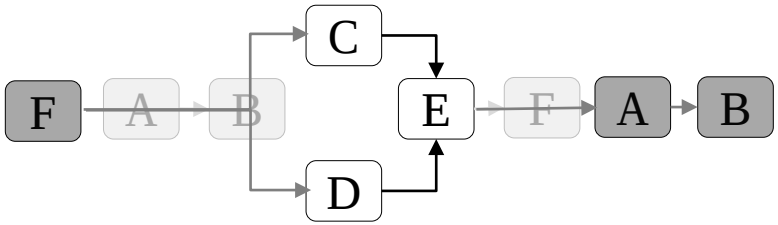
COLOR



SIZE



BRIGHTNESS



CHANGE TRACKING GRAPH A*

Design Criteria of Models - Examples

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Correctness Criteria

Examples

- Unique start and end node
- Connectivity
- Deadlock free

Aesthetic Criteria

Examples

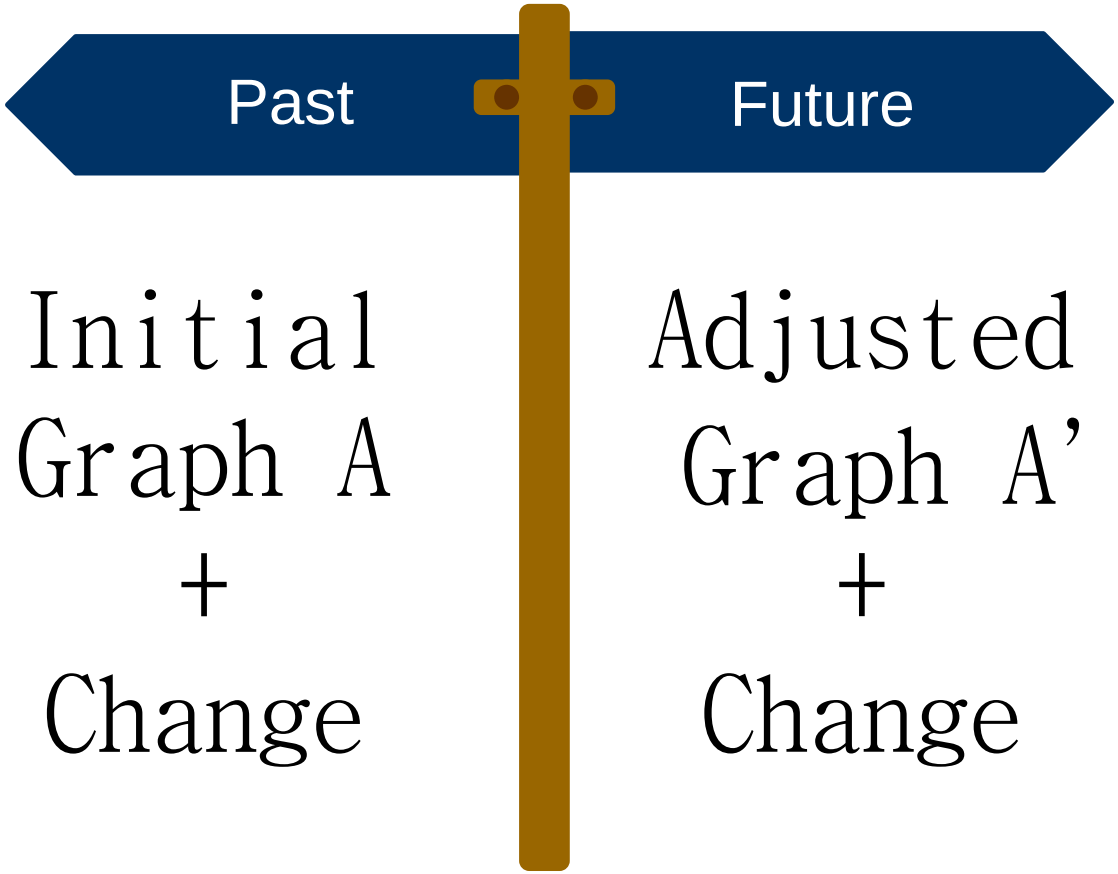
- Minimize edge crossing
- Minimize the number of overlapping elements
- Maximize symmetry
- Minimize layout size

Mental Map Criteria

Examples

- move as few nodes as possible
- move nodes as little as possible
- preserve the outer shape of the model
- preserve the inner shape of the model

Layouting



Mental Map
Criteria

Aesthetic
Criteria

Example - Layouting

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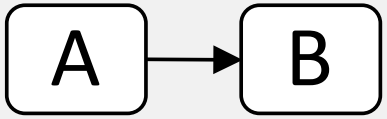
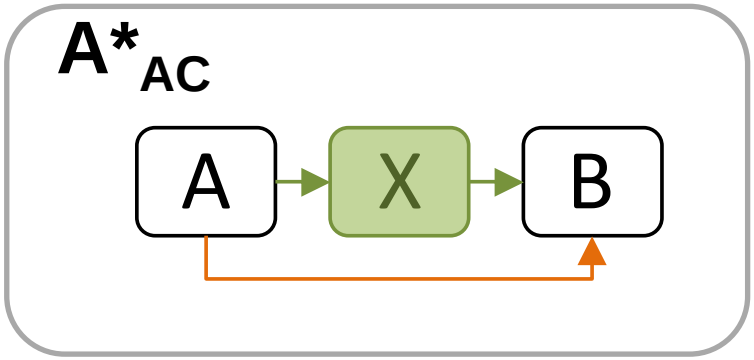
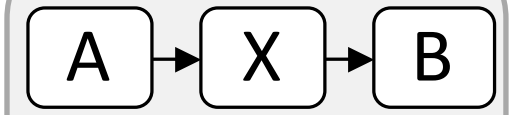
Initial Graph A



Change Tracking Graph A*

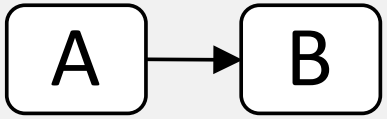


Adjusted Graph A'

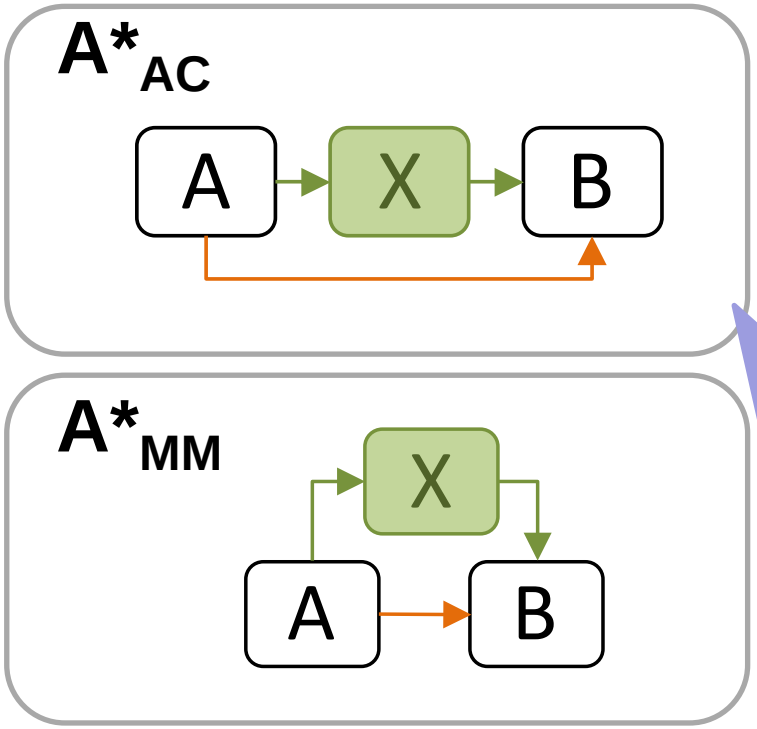


Example - Layouting

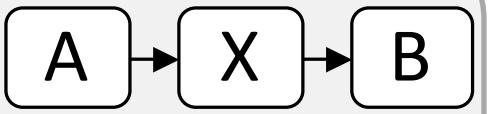
Initial Graph A



Change Tracking Graph A*



Adjusted Graph A'



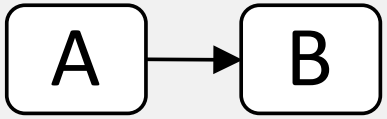
AESTHETIC CRITERIA

- focus on the control flow,
- minimization of edge crossing and number of overlapping elements,
- maximization of connecting node and edge orthogonality,
- and minimization of the number of bends.

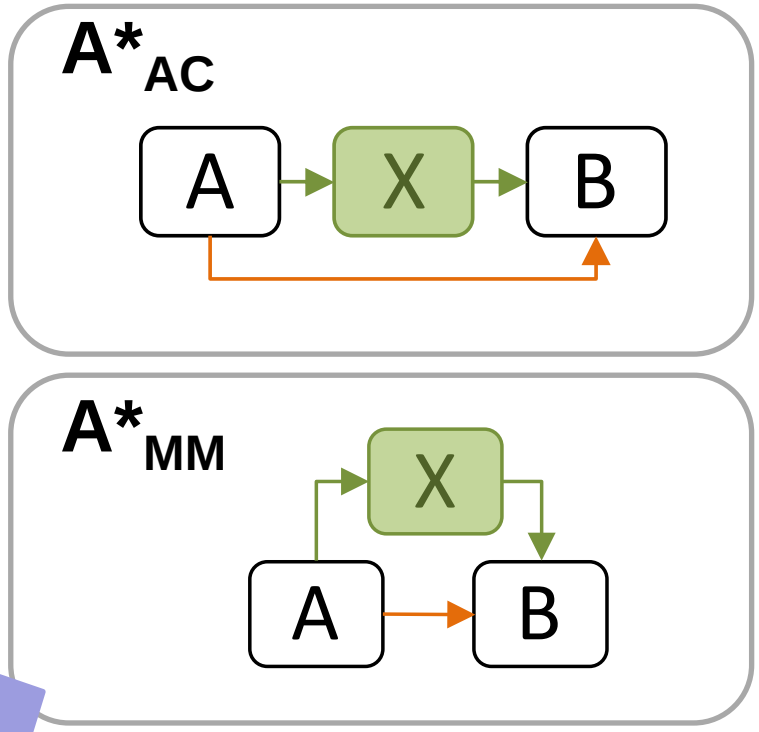
- **The inserted and initial graph elements are placed according to the aesthetic criteria first, and then the deleted elements are considered in the layout.**

Example - Layouting

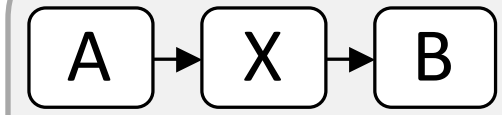
Initial Graph A



Change Tracking Graph A*



Adjusted Graph A'

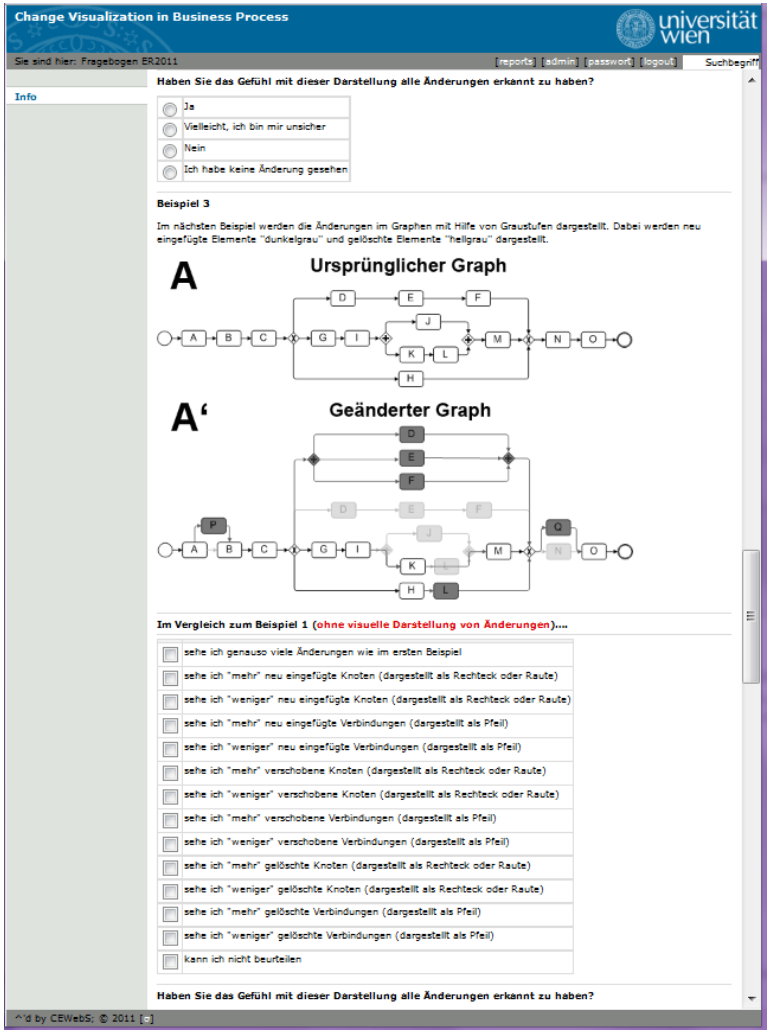


MENTAL MAP

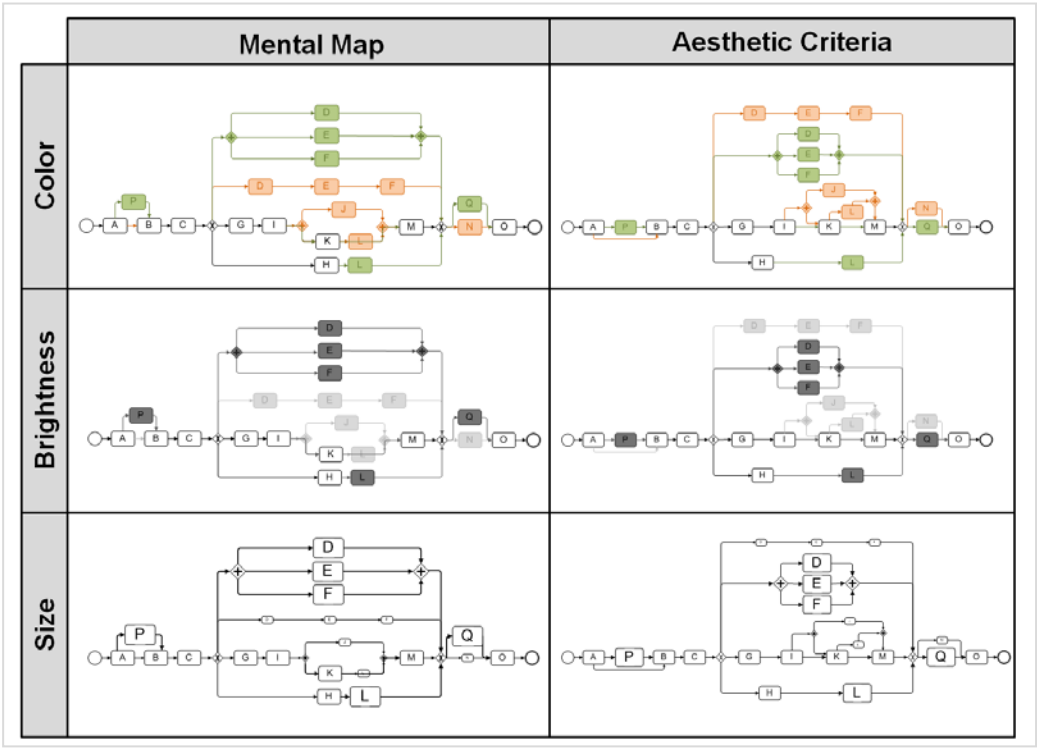
- moving as few nodes as possible
- and by moving the nodes as little as possible

- **Deleted elements remain on their initial positions in order to reflect the layout of A, and then the inserted elements are considered in the layout**

Survey



Examples:

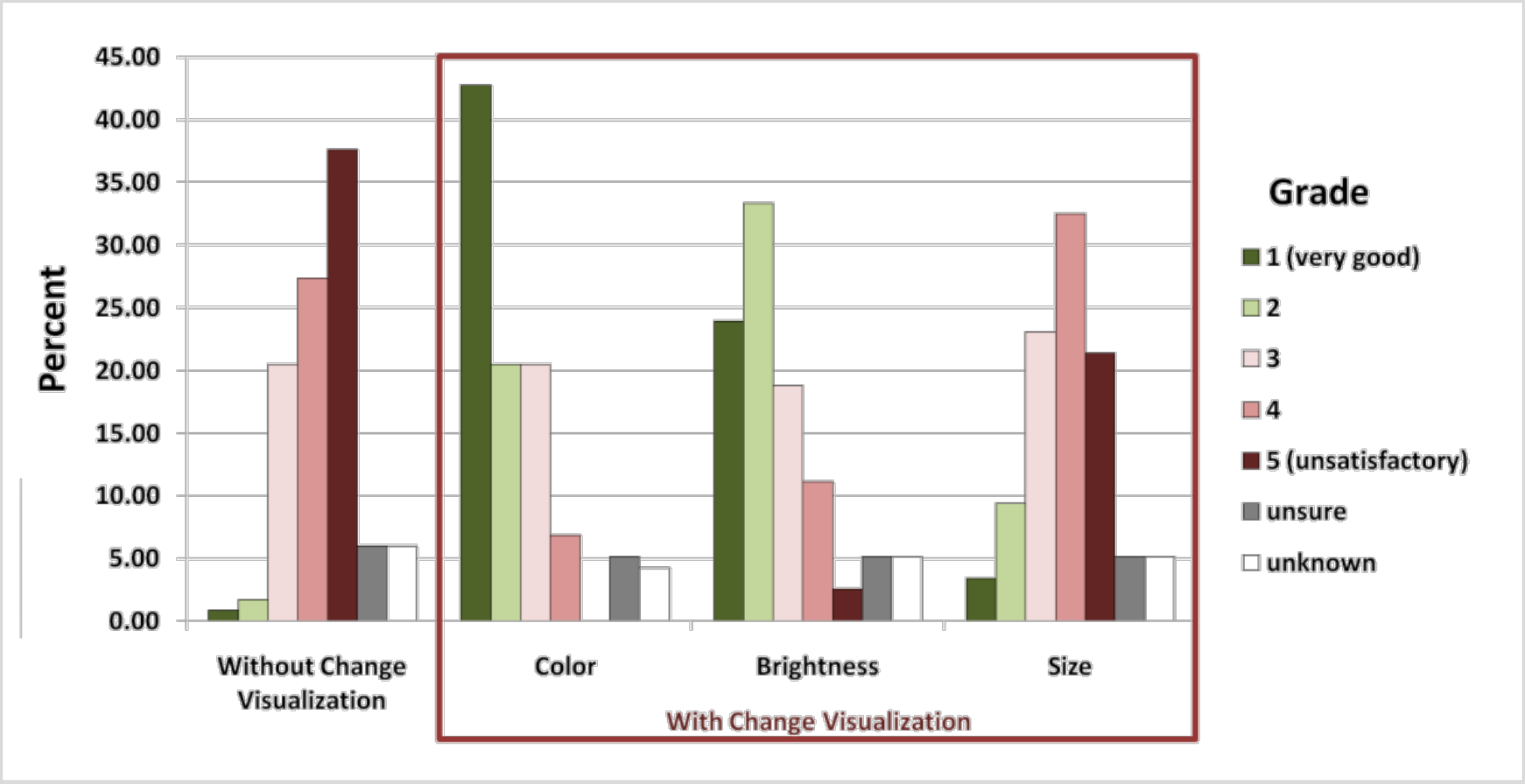


User Characteristics

Visual properties

Layout

Survey - Results



LAYOUT

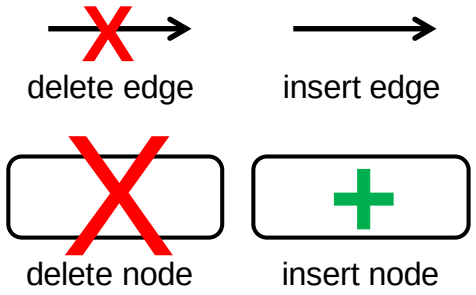
Past

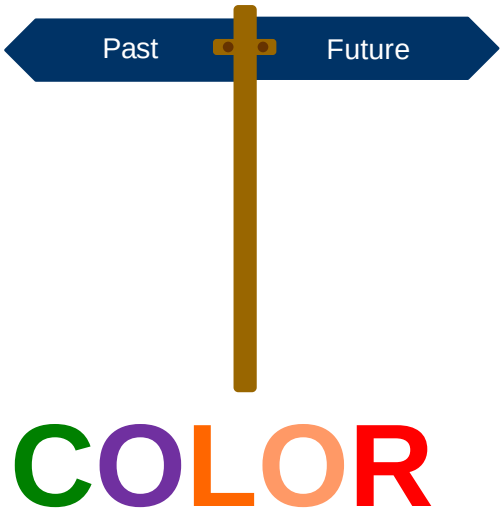
Future

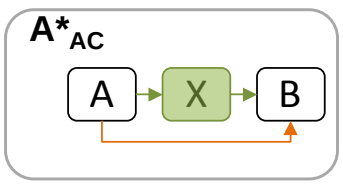
No clear favorite…

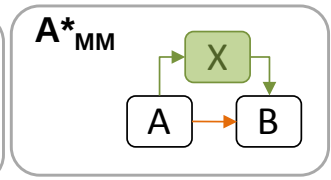
Conclusion

- Solution for change tracking in series-parallel graphs
- Change: delete and insert
- 2 Layouts – Past (Mental Map Criteria) and Future (Aesthetic Critera)
- Survey – User Preferences
  - Color to visualize change
  - The possibility to choose among the two layouts (past and future) should be offered to the process users









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