

KPI evolution patterns

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Introduction

This document includes 1) the specification format of the KPI evolution patterns, 2) five specific evolution patterns and 3) the relationships of propagation among them.

The five KPI evolution patterns included in this document are the following:

- Create KPI
- Delete KPI
- Update Calculation Rule
- Update Target
- Update Status Options

We that, the examples included to exemplify the use of each pattern belong to two different fields of application: the field of *education* and the field of *sustainability and green information technology*.

1. Specification format

Pattern <abbreviation>: <name>	
Description	<description of its functionality>
Examples	- <illustrative examples to clarify the pattern's use>
Motivation	<reasons that can trigger the change, especially indicating what elements (objectives, technology, processes, ...) may be related>
Traceability	<div><div>[T1] <Storage of the pattern application fact></div><div>[yes] → [T2] <Storage of the information related with the change that provokes the application of the pattern (goal, process, . . .)></div><div>[yes] → [T3] Keep the previous KPI specification in order to know the evolution over time.</div><div>[yes] → [T4] Keep the previous values of the KPI together with the previous KPI specification.</div></div>
Consistency conditions	<div>[C1] <Consistency conditions that can be compromised by the application of the pattern></div> <div>[C2] <Actions to be performed if any of the consistency conditions is not satisfied></div>
Propagation	<div>[P1] <Propagated actions derived as consequence of the application of a pattern></div> <div>[trace and any propagation] → [P2] <Storage of the propagation relationships between the applied patterns></div>
Related patterns (Influences)	<patterns that can be triggered as an effect of the application of this pattern>

2. KPI evolution patterns

2.1. Create KPI Pattern

Pattern CK: Create KPI	
Description	A new KPI is created
Examples	<ul style="list-style-type: none">- The adoption of an on-line learning system could lead to the consideration of a new KPI to calculate the percentage of students passing the exams without seeing the corresponding on-line lessons.- A poultry industry decides to reduce its environmental impact focusing on reuse of waste and, consequently, a KPI for calculating by-products generation is added (Shamsuddoha et al., 2015).
Motivation	Several business changes may lead to the need of introducing a new KPI, for example, a broader scope, a new goal or a new business process.
Traceability	<div><div>[T1] Store the fact that the creation pattern has been applied, linked to the created KPI.</div><div>[yes] → [T2] Store the information related with the reason that provokes the creation of a new KPI (broader scope, new goal, ...)</div></div>
Consistency conditions	<p><i>General consistence conditions</i> to be checked to make sure that the system would remain consistent if the KPI is created:</p> <div>[C1.1] <i>nonRepeatedName</i>: there is no other KPI with the same name.</div> <div>[C1.2] <i>uniqueness</i>: to check that the definition of an indicator is unique in the system, that is, there is no identical calculation rule (Diamantini et al., 2016),</div> <div>[C1.3] <i>inequivalence</i>: to make sure that a calculation rule is not equivalent to a calculation rule already in the system (Diamantini et al., 2016).</div> <div>[C1.4] <i>coherence</i>: to check that equivalence relations are preserved between system's indicators and their constituent parts/members. In this particular pattern, between system's indicators and calculation rules. More specifically, it must be checked that the calculation rule does not contradict any other already defined calculation rule (Diamantini et al., 2016).</div> <p><i>Actions</i>: If any of the conditions were not satisfied, the KPI would not be introduced in the system.</p>

Propagation

[P1.1] Modify the calculation rules of other KPIs as appropriate, making use of the new KPI, making use of pattern Update Calculation Rule (Pattern UCR).

[P1.2] Delete or create other KPIs, considering the creation of the new KPI, making use of patterns Delete KPI (Pattern DK) and Create KPI (Pattern CK).

[trace and any
propagation]

[P2] Store the propagation relationships between the pattern application facts stored because of the KPI creation.

Related patterns (Influences)

[P1.1] Update Calculation Rule (Pattern UCR)

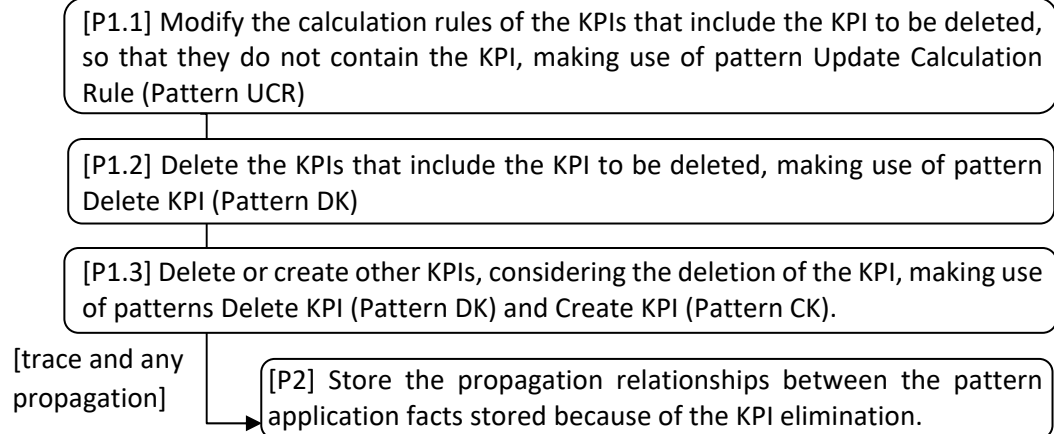
[P1.2] Delete KPI (Pattern DK)

[P1.2] Create KPI (Pattern CK)

2.2. Delete KPI Pattern

Pattern DK: Delete KPI	
Description	A KPI is deleted
Examples	<ul style="list-style-type: none">- An academic organization decides to abandon paper-based complains in favour of electronic/online complains. As a consequence, the KPI that controlled the number of paper-based complaints is no longer necessary.- A KPI calculating the recycled water used by an organization is deleted in order to be substituted by a KPI calculating the recycled water rate.
Motivation	Several business situations may lead to the need of eliminate a KPI, for example, the elimination of a business process or a goal.
Traceability	<pre>graph TD; T1["[T1] Store the fact that the deletion pattern has been applied."] --> T2["[T2] Store the information related with the reason that provokes the deletion of a KPI (process or goal elimination, ...)."]; T1 --> T3["[T3] Keep the previous KPI specification in order to know the evolution over time."]; T2 -- "[yes]" --> T3; T3 -- "[yes]" --> T4["[T4] Keep the previous values of the KPI together with the previous KPI specification."];</pre>
Consistency conditions	<p><i>General consistence conditions</i> to be checked to make sure that the system would remain consistent if the KPI is deleted:</p> <p>[C1] <i>coherence</i>: to check that equivalence relations are preserved between system's indicators and their constituent parts/members. In this particular pattern, between system's indicators and calculation rules (Diamantini et al., 2016).</p> <p><i>Actions</i>: If the condition is not satisfied, various policies could be implemented. We can distinguish several alternatives for action:</p> <p>[C2] If the <i>coherence</i> check is not satisfied because the KPI is part of the calculation rule of other KPIs, for each of those KPIs:</p> <ul style="list-style-type: none">- Try to infer a new calculation rule that does not contain the KPI. In case there is a calculation rule for which that is not possible, the KPI will not be deleted (Diamantini et al., 2016) (related to propagation [P1.1]).- Also delete the KPI (related to propagation [P1.2]). <p>In any other inconsistency case not considered previously, not to delete the KPI from the system (being this option the most common one).</p>

Propagation



Related patterns (Influences)

[P1.1] Update Calculation Rule (Pattern UCR)

[P1.2] [P1.3] Delete KPI (Pattern DK)

[P1.3] Create KPI (Pattern CK)

2.3. Update Calculation Rule Pattern

Pattern UCR: Update Calculation Rule	
Description	The calculation rule of a KPI is updated
Examples	<ul style="list-style-type: none"> - A modification in the evaluation criteria of an on-line course, penalizing the number of wrong answers, can imply a change in the KPI "Session Learning Adequacy per Training Step" (SLATS) (Calabro et al., 2015) adding, for example, a factor of 1.5 to the number of reloads. - A company supersedes the G4 Sustainability Guidelines (Global Reporting Initiative, 2013) for the GRI Standards (Global Reporting Initiative, 2016), so that the changes introduced in the GRI Standards must be considered in the calculation of KPIs.
Motivation	Several reasons can motivate a change in the calculation rule of a KPI, for example, a change in the goals of the company, a change in the business processes or a change in other KPIs involved in the calculation rule.
Traceability	<pre> graph TD T1["[T1] Store the fact that the update calculation rule pattern has been applied, linked to the new calculation rule."] T2["[T2] Store the information related with the reason that provokes the calculation rule modification (goal, process or KPI change, ...)"] T3["[T3] Keep the previous calculation rule in order to know the evolution over time."] T4["[T4] Keep the previous values of the KPI together with the previous calculation rule."] T1 -- yes --> T2 T2 --> T3 T3 -- yes --> T4 </pre>
Consistency conditions	<p><i>General consistence conditions</i> to be checked to make sure that the system would remain consistent if the KPI's calculation rule is updated:</p> <ul style="list-style-type: none"> [C1.1] <i>uniqueness</i>: to check that the definition of an indicator is unique in the system, that is, there is no identical calculation rule (Diamantini et al., 2016). [C1.2] <i>inequivalence</i>: to make sure that a calculation rule is not equivalent to a calculation rule already in the system (Diamantini et al., 2016). [C1.3] <i>coherence</i>: to check that equivalence relations are preserved between system's indicators and their constituent parts/members. More specifically, it must be checked that the calculation rule does not contradict any other already defined calculation rule (Diamantini et al., 2016), that is, any other dependent KPI. Additionally, it must be verified that the new calculation rule does not contradict targets and status options of the modified KPI. <p><i>Actions</i>: If any of the conditions are not satisfied, various policies could be implemented. We can distinguish several alternatives for action:</p>

[C2.1] If the *coherence* check is not satisfied because the new calculation rule is not coherent with the target or status options of the KPI, modify the target or the status options as consequently (related to propagation [P1.1]).

[C2.2] If the *coherence* check is not satisfied because the KPI to be modified is part of the calculation rule of other KPIs, for each of those KPIs, decide:

- keep the calculation rule as it is, including the modified KPI.
- redefine the calculation rule using the previous calculation rule of the modified KPI (related to propagation [P1.2]).

[C2.3] If the *coherence* check is not satisfied because of the existence of circular dependencies, avoid the evolution to be performed.

In any other inconsistency case not considered previously, not to modify the calculation rule of the KPI (being this option the most common one).

Propagation

[P1.1] Modify other KPI attributes, such as target or status options, as appropriate, making use of patterns Update Target (Pattern UT) and Update Status Options (Pattern USO).

[P1.2] Modify the calculation rules of dependent KPIs (KPIs whose calculation rules include the updated KPI), as appropriate, making use of pattern Update Calculation Rule (Pattern UCR).

[trace and any
propagation]

[P2] Store the propagation relationships between the pattern application facts stored because of the calculation rule modification.

Related patterns (Influences)

[P1.1] Update Target (Pattern UT)

[P1.1] Update Status Options (Pattern USO)

[P1.2] Update Calculation Rule (Pattern UCR)

2.4. Update Target Pattern

Pattern UT: Update Target	
Description	The target of a KPI is updated
Examples	<ul style="list-style-type: none"> - A university decides to include among its goals to attract more foreign students and, consequently, it increases the target value of an existing KPI for measuring the number of foreign students. - A company decides to follow green strategies and, consequently, reduces the target value of existing KPIs for measuring the energy consumption (Murugesan et al., 2012).
Motivation	A change in the objectives of the company may influence the target value (increasing or decreasing) of the KPIs related to these objectives
Traceability	<pre> graph TD T1([T1] Store the fact that the update target pattern has been applied, linked to the new target.) --> D1{[yes]} D1 --> T2([T2] Store the information related with the reason that provokes the target modification (objectives change,...).) T2 --> D2{[yes]} D2 --> T3([T3] Keep the previous value of the target in order to know the evolution over time.) T3 --> D3{[yes]} D3 --> T4([T4] Keep the previous values of the KPI together with the previous target value.) </pre>
Consistency conditions	<p><i>General consistence conditions</i> to be checked to make sure that the system would remain consistent if the target of the KPI would be modified:</p> <div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> <p>[C1] <i>coherence</i>: to check that equivalence relations are preserved between system's indicators and their constituent parts/members (Diamantini et al., 2016). In particular, it must be verified that the new target does not contradict neither the KPI's status options nor the targets and status options of its dependent KPIs.</p> </div> <p><i>Actions</i>: If the condition is not satisfied, various policies could be implemented. We can distinguish several alternatives for action:</p> <div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> <p>[C2.1] If the <i>coherence</i> check is not satisfied because the new target is not coherent with the status options of the KPI, modify the status options, as consequently (related to propagation [P1.1]).</p> </div> <div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> <p>[C2.2] If the <i>coherence</i> check is not satisfied because the new target is not coherent with the target or status options of any dependent KPI, for each of such dependent KPIs, modify the target or the status options as consequently (related to propagation [P1.2]).</p> </div> <p>In any other inconsistency case not considered previously, not to modify the target of the KPI (being this option the most common one).</p>

Propagation

[P1.1] Modify the status options of the KPI, making use of pattern Update Status Options (Pattern USO).

[P1.2] Modify other attributes of dependent KPIs (KPIs whose calculation rules include the updated KPI), such as target or status options, as appropriate, making use of patterns Update Target (Pattern UT) and Update Status Options (Pattern USO).

[trace and any propagation]

[P2] Store the propagation relationships between the pattern application facts stored because of the target modification.

Related patterns
(Influences)

[P1.1] [P1.2] Update Status Options (Pattern USO)

[P1.2] Update Target (Pattern UT)

2.5. Update Status Options Pattern

Pattern USO: Update Status Options	
Description	The status options of a KPI are updated
Examples	<ul style="list-style-type: none"> - A university decides to include among its goals to attract more foreign students and, consequently, it modifies the intervals representing each status (<i>good</i>, <i>acceptable</i> and <i>bad</i>) of an existing KPI for measuring the number of foreign students. In particular, the minimum value of the interval corresponding to the <i>good</i> status is increased. - A company decides to follow green strategies and, consequently, modifies the intervals representing each status (<i>good</i>, <i>acceptable</i> and <i>undesirable</i>) of an existing KPI for measuring the energy consumption (Murugesan et al., 2012). In particular, the maximum value of the interval corresponding to the <i>good</i> status is reduced.
Motivation	A change in the objectives of the company may influence the status options, and their corresponding intervals, of the KPIs related to these objectives
Traceability	<pre> graph TD T1["[T1] Store the fact that the update status options pattern has been applied, linked to the new status options."] T2["[T2] Store the information related with the reason that provokes the status options modification (objectives change,...)."] T3["[T3] Keep the previous values of the status options in order to know the evolution over time."] T4["[T4] Keep the previous values of the KPI together with the previous status options."] T1 --> T2 T2 --> T3 T3 --> T4 </pre>
Consistency conditions	<p><i>General consistence conditions</i> to be checked to make sure that the system would remain consistent if the status options of the KPI would be modified:</p> <p>[C1] <i>coherence</i>: to check that equivalence relations are preserved between system's indicators and their constituent parts/members (Diamantini et al., 2016). In particular, it must be verified that the new status options do not contradict neither the KPI's target nor the status options of its dependent KPIs.</p> <p><i>Actions</i>: If the condition is not satisfied, various policies could be implemented. We can distinguish several alternatives for action:</p> <p>[C2.1] If the <i>coherence</i> check is not satisfied because the new status options are not coherent with the target of the KPI, modify the target, as consequently (related to propagation [P1.1]).</p> <p>[C2.2] If the <i>coherence</i> check is not satisfied because the new status options are not coherent with the status options of any dependent KPI, for each of such dependent KPIs, modify the status options as consequently (related to propagation [P1.2]).</p> <p>In any other inconsistency case not considered previously, not to modify the status options of the KPI (being this option the most common one).</p>

Propagation

[P1.1] Modify the target of the KPI, making use of pattern Update Target (Pattern UT).

[P1.2] Modify the status options of dependent KPIs (KPIs whose calculation rules include the updated KPI), as appropriate, making use of pattern Update Status Options (Pattern USO).

[trace and any propagation]

[P2] Store the propagation relationships between the pattern application facts stored because of the status options modification.

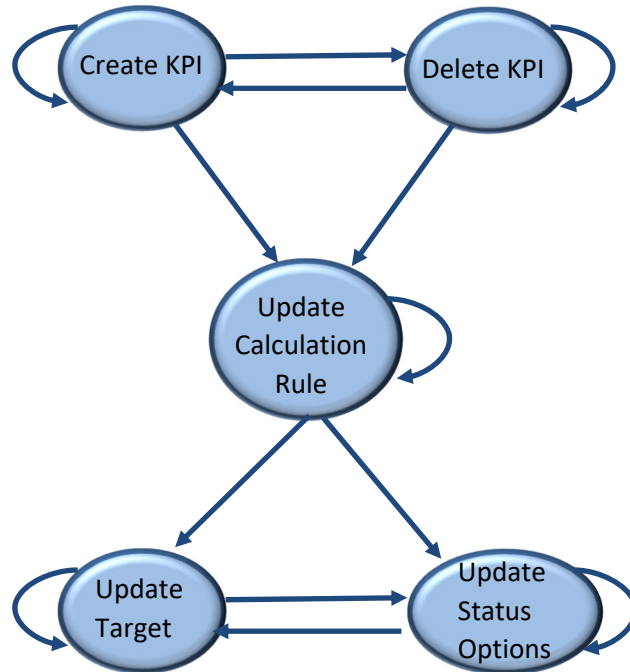
Related patterns
(Influences)

[P1.1] Update Target (Pattern UT)

[P1.2] Update Status Options (Pattern USO)

3. Relationships of propagation between patterns

The following image represents the propagation relationships between the patterns included in this document. Each arrow indicates that one pattern influences another, that is, if the source pattern is applied, then the target pattern must be analyzed to decide if it should be applied.



References

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