Using the SPEval tool for effort allocation and saving optimization: An example

In this document, we want to show the results of using the SPEval tool for solving the effort allocation and saving optimization problems. We start describing our dataset, available at https://github.com/ross85/SPEval. We consider in input to service portfolio management the production lines pl_1, pl_2 and pl_3, see Table 1, where a unique global identifier is associated to each service. At the beginning of the analysis, the unique PEq class is composed of services S7 in pl_1 and S11 in and pl_2.

Table 1: list of services in pl_1, pl_2 and pl_3

ID	pl	Service name
S1	pl_1	car crash detection service
S2	pl_1	tracking service
S3	pl_1	sanctions service
S4	pl_1	monitoring service
S5	pl_1	integrated notification service
S6	pl_1	archiving and digitalizing service
S7	pl_1	payment service
S8	pl_1	integrated reporting on car crashes
S9	pl_1	access to fines
S10	pl_2	authorization to open a cafeteria
S11	pl_2	payment service
S12	pl_2	documentation storage
S13	pl_2	multi-channel notification service
S14	pl_3	hotel reservation service
S15	pl_3	room assignment service
S16	pl_3	purchase

Interviews to managers revealed that production lines pl_1, pl_2 and pl_3 were characterized by loose interaction; Figure 1 represents the local repositories of services in pl_1, pl_2 and pl_3, where services S7 and S11 are highlighted as production equivalent.

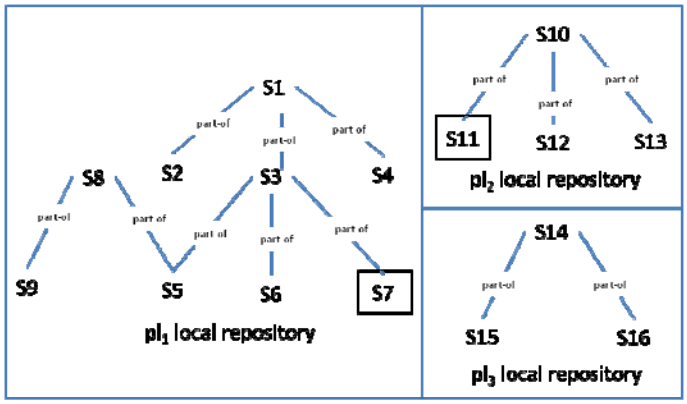

Figure 1: local repositories of *pl*$_1$, *pl*$_2$ and *pl*$_3$.

The analysis of the local repositories resulted in the identification of the non trivial CEq classes: i) services S7 and S11 (payment service) in *pl*$_1$ and *pl*$_2$ are conceptual equivalent to S16 (purchase) in *pl*$_3$; ii) S5 (integrated notification service) in *pl*$_1$ is conceptual equivalent to S13 (multi-channel notification service) in *pl*$_2$; iii) S6 (archiving and digitalizing service) in *pl*$_1$ is conceptual equivalent to S12 (documentation storage) in *pl*$_2$. Table 2 shows the service portfolio where each service, identified by the production line in which it is produced plus its global indicator, is characterized by its current design stage and the effort in the different stages expressed in person/hours (cells filled in grey represent efforts spent so far). Table 3 shows adaptation costs associated to the non trivial CEq classes identified by the analysis of the local repositories**.**

Table 2: current state of the service portfolio

s in SP	**cds**	**ef(s,st$_1$)**	**ef(s,st$_2$)**	**ef(s,st$_3$)**	**ef(s,st$_4$)**	**ef(s,st$_5$)**
pl$_1$.S1	1	25	10	35	15	30
pl$_1$.S2	2	10	5	15	10	15
pl$_1$.S3	1	15	10	15	10	20
pl$_1$.S4	3	10	5	15	15	25
pl$_1$.S5	1	10	15	15	5	30
pl$_1$.S6	2	5	5	15	5	10
pl$_1$.S7	2	10	5	10	10	10
pl$_1$.S8	1	20	10	35	20	35
pl$_1$.S9	2	15	5	30	10	30
pl$_2$.S10	1	40	10	35	20	45
pl$_2$.S11	2	0	0	10	10	10
pl$_2$.S12	2	5	5	15	5	10
pl$_2$.S13	4	10	15	15	5	30
pl$_3$.S14	2	15	10	15	20	15

pl_3.S15	2	10	5	10	20	15
pl_3.S16	2	10	5	10	10	10

Table 3: Adaptation costs of (non trivial) CEq classes

CEq(s)	ac(CEq,st_1)	ac(CEq,st_1)	ac(CEq,st_1)	ac(CEq,st_1)	ac(CEq,st_1)
pl_1.S5; pl_2.S13	1	2	2	1	3
pl_1.S6; pl_2.S12	1	1	2	1	1
pl_1.S7; pl_2.S11; pl_3.S16	1	2	2	2	2

Effort allocation problem

Here we focus on the following production objectives (a detailed description is reported in "Comerio et Al. *Service Portfolio Management: a Repository-based Framework*. Under review"):

- Q3: Given a set of production lines, which is the maximum set of services that can be led to the last stage of the design process using an extra effort *ef*?
- Q4: Given the portfolio *PS*, which is the maximum set of services that can be led to the last stage of the design process using an extra effort *ef*?

In Figure 2, referring to objectives Q3 and Q4, we show how SPEval proceeds in the effort allocation problem for different input efforts (effbound in the following).

As for objective Q3, with an effbound = 30, the tool selects pl_1.S7 and pl_2.S11 among services with cost to completion ≤ 30 person/hours. These services correspond to the unique non trivial PEq class. Further, additional effort (effbound = 60 and effbound = 90) is allocated to a. the same services, b. pl_2.S13 and c. pl_3.S12, achieving the objective maximization. As for objective Q4, when the service portfolio is available with an effbound = 50 the tool selects, among services with cost to completion ≤ 50, pl_1.S7, pl_2.S11 and pl_3.S16, that are in the CEq class with the highest cardinality. Then, additional effort is allocated to a. the same services pl_1.S7, pl_2.S11 and pl_3.S16, b. pl_1.S6 and pl_2.S12 that are in CEq classes with cardinality>1.

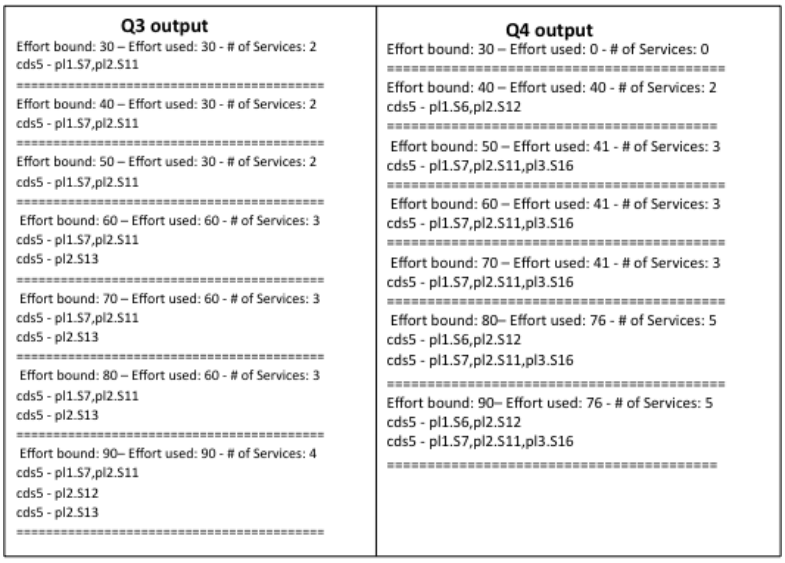

Figure 2: output for Q3 and Q4 production objectives

To be noticed that with effbound =30 the result of Q3 outperforms Q4. The reason is that, considering the new discovered CEq classes and the adaptation costs, there are not services that can be finalized with 30 person/hours. In Q3, pl_1.S7 and pl_2.S11 are selected. In Q4, when the portfolio, pl_1.S7 and pl_2.S11are in the same CEq of pl_3.S16 and they have a total adaptation cost of 9 person/hours. So, the CEq class with pl_1.S7, pl_2.S11 and pl_3.S16 can be finalized only with effbound $\geq$ 39.

Saving optimization problem

Here we focus on the following production objectives (a detailed description is reported in "Comerio et Al. Service Portfolio Management: a Repository-based Framework. Under review"):

- Q5: Given the portfolio PS, which is the set of services that are led to the last stage in the design process while maximizing savings using an extra effort ef?
- Q6: Given the portfolio PS, which is the set of design stages that are performed while maximizing savings using an extra effort ef?

In Figure 3, referring to objectives Q5 and Q6, we show how the tool proceeds in the saving optimization problem for different input efforts.

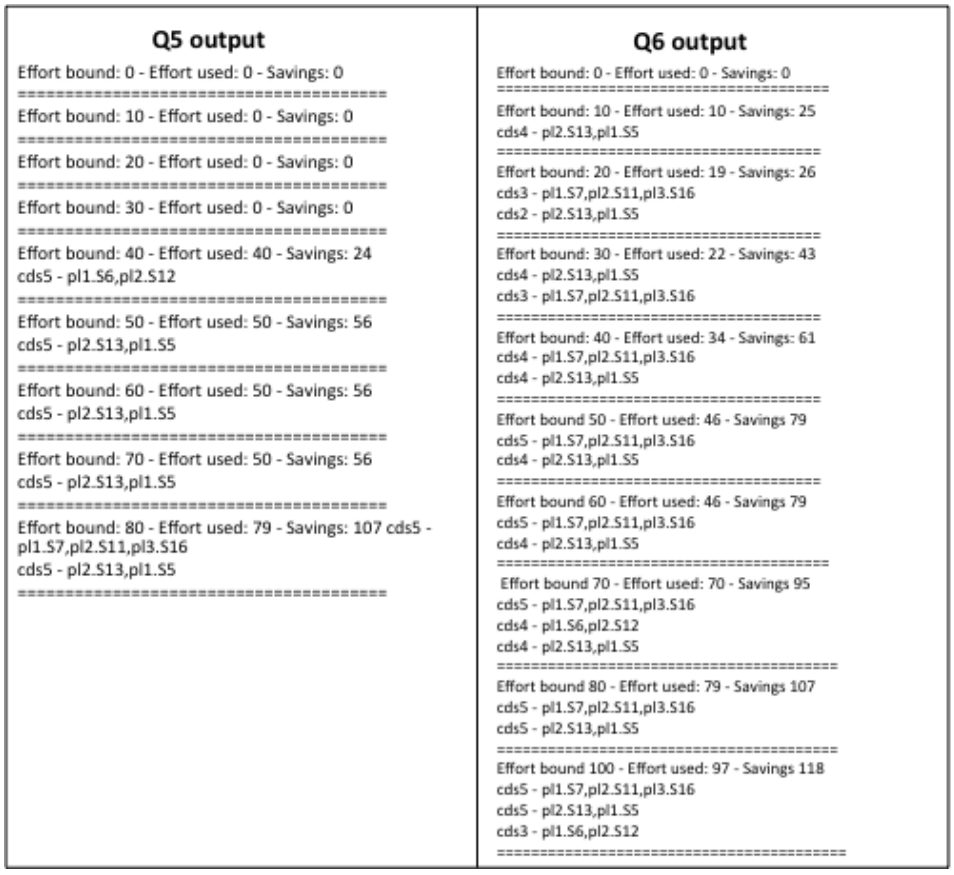

Figure 3: output for Q5 and Q6 production objectives

With an effbound = 50 person/hours, the tool selects pl_1.S5 and pl_2.S13 in Q5. With the same input effort, for objective Q4 selected services were pl_1.S7, pl_2.S11 and pl_3.S16 (see Figure 2). The reason is that in Q4 the effort is allocated to maximize the number of finalized services; instead in Q5 it is used to maximize savings: the selection of pl_1.S5 and pl_2.S13 allows the completion of such services, capitalizing overall savings for 56 person/hours; the selection of pl_1.S7, pl_2.S11 and pl_3.S16 enables the completion of a larger number of services, with (minor) savings of 51 person/hours. Additional effort (effbound = 60 and effbound = 90) is used to complete services in CEq classes with cardinality > 1 (i.e., the only services allowing savings). Further effort (effbound = 120) is not used since it is not possible to achieve new savings.

Let us now consider target Q6, i.e., saving optimization without the constraint of finalizing services, and having the freedom of reaching whatever stage of the service design process. Even with a little effort (effbound=10), due to the new knowledge available on CEq classes, the tool yields savings for 25 person/hours; this is due to the merging of the design processes of pl_1.S5 and pl_2.S13, that are in the same CEq class. When input effort is little more (effbound = 20 and effbound = 30 person/hours), the tool adds further savings resulting from the selection of design stages 3 for services pl_1.S7, pl_2.S11 and pl_3.S16 plus design stage 4 for services pl_2.S13 and pl_1.S5. Notice the different behaviors of the tool for Q5 and Q6 with a same effbound = 40: Q5 is achieved with the completion of pl_1.S6 and pl_2.S12 and savings for 24 person/hours; Q6 is achieved with the reach of stage 4 for pl_1.S7, pl_2.S11, pl_3.S16, pl_1.S5 and pl_2.S13 and savings of 61 person/hours. This is due to the removal in Q6 of the constraint in Q5 of finalizing services.