correlation between the number of iterations and the fitness ($p < 0.001$). Our algorithm so has an ascertainable influence on the evolvement of better individuals. For the extern validity, we tested the significant fitness increase towards the fitness of the gold reference PNs for all scenarios over all runs (h0: *cur_fitness* < gold_fitness; $p < 0.001$). The relation between the gold reference PN and the minimum fitness was always significantly greater than 1.0. That is an assertive indicator for our algorithm to be able to generate efficient reference PNs for various scenarios. All gold RMs were evaluated to be highly efficient and fit. This speaks for the validity of our approach because arbitrary models out of the initial population are significantly less efficient (h0: *fitness(generatePN(m), Models)* > *fitness(generatePN (gold_PM), Models)* for each PM *m* in the input PMs *Models* and the respective gold RM; $p < 0.01$). That means that the generated PN around the gold RM is efficient for all input PMs. Considering the low density and the random assignment of capabilities to performers in an efficient generated PN, its performers have only the most critical capabilities to work on the most critical process functions over all input PMs. This also means that the gold RMs' efficiency can be compared to other RMs for the input PMs which makes our fitness function a valid indicator for the quality of a RM.

The advantage of our approach is that the RMs can be generated valid over different domains. The proposed PN/RM combination describes a minimum topology of performers and their assigned process functions that is efficient towards the set of given input PMs. This proposed PN and RM can be adapted for specific stated requirements such as pre-given teams or pre-assigned performers to certain process functions. For a real environment, their efficiency comparing to other team/hierarchy constellations can then be simulated and evaluated. The RM in figure 3, as an example, indicates that the work flow between "Booking company car", "Ordering rental car" and "Checking the decision" is most critical for the efficiency of all process variants in S3 as they have the highest degrees of all process functions which makes them central in the RM. These process functions lie on critical paths in most process variants in S3, in the meaning of paths that reach from start nodes to end nodes and lie on many other paths at the same time. For that reason, most of all hub performers, such as "Kirk" "Jeremiah" and "Heath", were placed to work with their subordinated teams at this process functions. This can be interpreted as a recommendation or reference for a modeller to focus on needed capabilities for this process region when positioning real personal, e.g. at checking the decision for booking a car.

Limitations: Our approach focusing only on PN/PM topology is quite abstract and based on simplified assumptions about real processes and organizations. Organizations in our approach only consist of a set of performer networks and PMs. Their execution environment, social behaviour, resource allocation, communication- and production/processing capacities are not considered. In order to demonstrate the potential of our approach, the implemented algorithm produces quickly an acceptable result but will hardly reach a global optimum. For achieving a much better result, the number of performers should be reduced nearly to the number of needed performers in the gold RMs. An adapted, organization-specified implementation that considers

the environment, the concrete performer capabilities and restrictions for their process assignment will be imperative for our approach to be utilized by practitioners.

5 Conclusion

In this paper we introduce a new concept for the inductive development of reference process models. A social perspective for matching the process flow is applied, rather than a traditional label matching which is an inexact and subjective approach. For a given set of input PMs, a reference process model is developed, in a few seconds of runtime, by including all process functions that are minimum requirements for the resulting model to be efficient. The efficiency is measured by the time that simulated performers need to complete the process. Three evaluation scenarios are provided to evaluate our approach. The evaluation indicates that the generated reference process models are at least as efficient as the input PMs and as a RM designed by an expert. Our results confirm the potential of our approach as they confirm its extern validity.

From a theoretical point of view that means that the efficiency of RMs designed by experts can be compared to our developed RMs which makes our fitness function a valid indicator for the quality of a RM. This in turn implies social collaboration to be an important facet for reference modelling. Our approach can be tailored to concrete organizations and processes. Practitioners take advantage of pre-selecting efficient sub corpora out of many models and identifying maybe invisible lead performers / critical junctures, in contrast to the formal structure, constituting efficient structures of co-worker ship around process models.

In future works, we want to provide a method to evaluate the quality of reference process models based on this approach. Also we will evaluate event logs of the execution of business processes to add a time/cost component to our fitness function for developing reference process models.

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