Choicla: Intelligent Decision Support for Groups of Users in the Context of Personnel Decisions

Martin Stettinger
Institute for Software Technology
Inffeldgasse 16b
A-8010, Graz, Austria
mstettinger@ist.tugraz.at

Alexander Felfernig
Institute for Software Technology
Inffeldgasse 16b
A-8010, Graz, Austria
afelfern@ist.tugraz.at

ABSTRACT
Group recommendation technologies have been successfully applied in domains such as interactive television, music, and tourist destinations. Existing technologies are focusing on specific domains and do not offer the possibility of supporting different kinds of decision scenarios. The *Choicla* group decision support environment advances the state of the art by supporting decision scenarios in a domain-independent fashion. In this paper we present an overview of the *Choicla* environment and exemplify it's application in the context of personnel decisions.

Categories and Subject Descriptors
D.2 [**Software and its engineering**]: Software creation and management; H.5 [**Information Interfaces and Presentation**]: Modelling Environments

General Terms
Algorithms; Human Factors; Experimentation

Keywords
Recommender Systems, Group Recommendation, Group Decision Making, Personnel Decisions

1. INTRODUCTION
Decisions in everyday life often come up in groups, for example, a decision about the destination for the next holidays or a decision about which restaurant to choose for a dinner. Knowledge about the preferences of other users in early phases of a decision process can lead to sub-optimal decision outcomes [12]. Missing explanations can lead to a lower level of trust in recommendations [2]. So-called anchoring effects [6] are responsible for decisions which are biased by the voting of the first preference-articulating person. If single persons have to take a decision in place of persons who are not available for a meeting, the outcome of the decision can also be negatively influenced. Decision processes are often not open in the sense that it is impossible to easily integrate new decision alternatives or change the individual preferences within the scope of a decision process - both aspects can lead to low-quality decision outcomes (see [13]). In many cases, the criteria for the decision remain unclear since there is no explanation of the outcome of "the final decision". All these mentioned threats can negatively influence the quality of group decisions.

One major goal of the *Choicla* environment is to facilitate group decision making and improve the overall quality of decision outcomes. The idea of this environment is to support definitions of different types of decision tasks in a domain-independent fashion while taking into account the above mentioned risk factors. In order to achieve this goal, *Choicla* builds upon different group recommendation algorithms [11] which are used for determining alternative solutions for the participants of a group decision process.

One example of the application of *Choicla* is to support groups of users in context of personnel decisions with the aim of achieving a more structured, fair, and transparent way of job interviews as well as to find the most suitable candidate for the job advertisement. Other typical scenarios for the application of *Choicla* technologies are the decision about which restaurant to select for a dinner or - in a scientific community - a decision regarding the selection of the destination of next year's conference.

The remainder of this paper is organized as follows. In Section 2 we provide insights to (1) the *Choicla* modelling process where participants can design decision tasks from scratch and (2) the intelligent management of already created decision apps. In the Section 3 we give an overview of the personnel decision scenario. We then discuss related & future work (Section 4) and thereafter conclude the paper (Section 5).

2. CHOICLA DECISION SUPPORT
Because decision scenarios differ from each other in their process design, a variety of parameters is needed to specify all relevant properties of a decision task. We will now discuss basic features (parameters) which can be configured (modelled) by the creator of a decision task. In this context we refer to the example features depicted in Figure 1.

2.1 Design of Decision Apps
Because decision scenarios differ from each other, some decision scenarios rely on a preselected decision heuristic that

IntRS 2014, October 6, 2014, Silicon Valley, CA, USA.

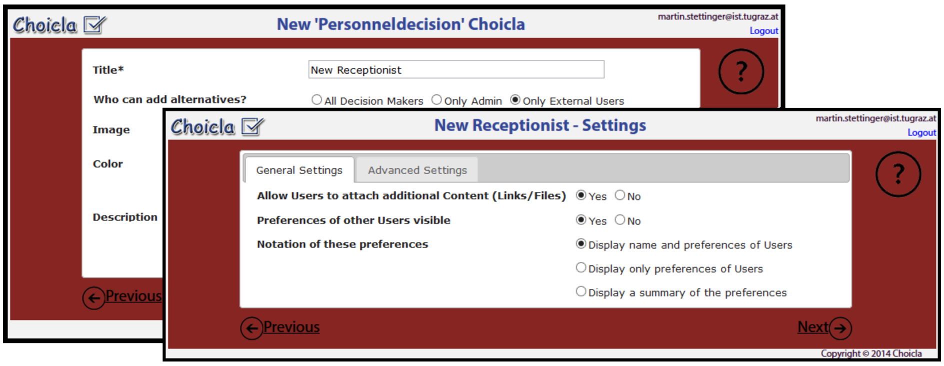

Figure 1: *Choicla*: definition of a decision task. Basic settings & further configurable features.

defines the criteria for taking the decision, for example, a group decides to use *majority voting* for deciding about the next restaurant or cinema visit. The design of decision tasks (the underlying process) can be interpreted as a configuration problem (see [17]). The achieved flexibility of making the process design of a decision task configurable is needed due to the heterogeneity of decision problems. This way the *Choicla* components are organized as a kind of a software product line that is open in terms of the implementation (generation) of problem-specific decision applications.

Explanations. Explanations can have an important role in decision tasks since they are able to increase the trust of users in the outcome of a decision process [2]. When designing a decision task in *Choicla*, explanations can be selected as a feature of the decision process. If this feature is selected, the administrator of a decision task has to enter some explanatory text, if not, the entering of such a text remains just an option.

Administration of Decision Alternatives. The administration of decision alternatives within the scope of a decision task can be supported in different ways. *First*, only the initiator of a decision task is allowed to add alternatives – this could be desired if a person is interested in knowing the opinions of his/her friends about a concrete set of alternatives (e.g., alternative candidates for the next family car). Another related scenario are so-called "Micro-Polls" where the initiator is only interested in knowing the preference distribution of a larger group of users. *Second*, in some scenarios it is important that all decision makers can add alternatives during the decision task by themselves – a common example of such a scenario is the group-based decision regarding a holiday destination or a hotel [7]. In such a context, each participant should be allowed to add relevant alternatives. The support of group-based personnel decisions can be seen as an example scenario of the *third* case (only external users can add alternatives) – in this context it should be possible that candidates apply for a certain job position (the application itself is interpreted as the addition of a new alternative to the decision task). The selection of the next conference location where proposers can submit their material is another example.

Preference Visibility. The scope "private" allows only invited users to participate, i.e., the decision task is only accessible for invited users and not accessible for other users. If the scope is "public", the decision task is accessible for all users – this is typically the case in the context of so-called Micro-Polls. The decision quality can be influenced if the individual preferences of the other participants are visible during the decision process (see [3] and [7]). There exist decision scenarios where all participants profit from the knowledge of who entered which rating. If, for example, the decision task is to find a date for a business meeting it is essential to find a date where all managers can attend the meeting and therefore it is important to know the individual preferences of the participants. On the other hand there are decision scenarios where full preference visibility can lead to disadvantages for some participants but some kind of transparency of the individual preferences is helpful to achieve a reasonable decision. In such cases a summary of all given preferences is a feasible way to support decision makers (participants). A summary prevents the participants from statistical inferences to the individual preferences but still can help participants who are unsure about how to rate.

Recommendation Support. In the context of group decision tasks, an essential aspect is the aggregation function (recommendation heuristic). In a group decision process aggregation functions can help to foster consensus. User studies show that these functions also help to increase the degree of the perceived decision quality (see, for example [3]). Individual user preferences can be aggregated in many different ways and there exists no default heuristic which fits for every decision scenario. To provide a support for groups of users in different decision scenarios, the selection of recommendation heuristics is a key feature which has to be configured by the initiator of a decision task. Due to space limitations we only describe selected aggregation heuristics below. Masthoff [11] gives an overview of basic aggregation heuristics such as *Majority Vote (MAJ)*, *Average Vote (AVV)*, *Least Misery (LMIS)*, and *Most Pleasure (MPLS)* which are also available in the *Choicla* environment.
Group Distance (GD) (see Formula 1) returns the value d as group recommendation which causes the lowest overall change of the individual user preferences where $eval(u, s)$ denotes the rating for a solution s defined by user u.

$$GD(s) = minarg_{(d \in \{1..5\})}\left(\sum_{u \in Users} |eval(u,s) - d|\right) \quad (1)$$

Ensemble Voting can be seen as an example of a meta-aggregation function included in *Choicla*. Ensemble Voting (see Formula 2) determines the majority of the results of the individual voting strategies $H = \{\text{MAJ, AVV, LMIS, MPLS, GD}\}$ where $eval(h, s)$ denotes the result of an individual voting strategy for a solution s.

$$ENS(s) = maxarg_{(d \in \{1..5\})}(\#(\bigcup_{h \in H} eval(h, s) = d)) \quad (2)$$

2.2 Choicla Decision Apps

After the design process has been finished, the creator of the decision task as well as all invited participants (after accepting the invitation) see a corresponding decision app directly on the personal home screen (see Figure 2).

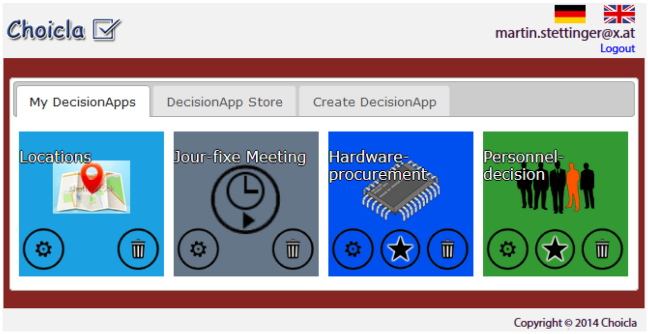

Figure 2: *Choicla*: Home screen of a registered user. The symbols within the tiles trigger actions which can be performed in the current state of the decision app. Possible actions are (from left to right): configuration, evaluation (only possible if the decision app is publicly available over the store), and delete.

The tab *DecisionApp Store* contains publicly available decision apps which can be searched and installed on the personal *Home Screen*. This method prevents a creation from scratch every time for frequent decision tasks such as, for example, scheduling decision tasks. In such a case the decision process can be triggered right after the download of a decision app. This reuse technique has the potential to reduce the entry barrier for using *Choicla* and keep the interaction simple – especially for people who want to start a decision process quickly. The tab *Create DecisionApp* allows a user to design a completely new decision app from scratch.

Due to the fact that many decision tasks occur regularly – for example, a group of friends go for dinner once a month – a concept is needed to manage a potentially large number of decision tasks. To keep the potentially large number of decision tasks manageable, every decision app consists of a variable number of instances. A concrete instance of a decision app can be accessed within the corresponding decision app - all instances of a concrete decision app will be loaded when the decision app is opened. The created instance of the example depicted in Figure 1 is accessible in the "Personnel-decision" app (see Figure 2). This mechanism offers the possibility of an exact documentation of all past decisions and is also a basis for supporting recurring decision tasks.

3. CHOICLA PERSONNEL DECISIONS

3.1 Users View

Personnel decisions are often influenced by various factors. Such factors are, for example, if a candidate has physical handicaps, in most cases no concrete structure is followed during the job interview and the evaluation often gets subjective. In such a case the assessment criteria of the candidates change and no "fair" and objective decision can be made. Another important factor is that in most cases personnel decisions come up in groups of users which means that often more than one person is affected by the hiring procedure.

To prevent groups from unsystematic reviews, *Choicla* offers a structured and fair way to evaluate candidates of a job position. Figure 3 shows the evaluation of the candidates in context of our working example (new receptionist) for a particular decision maker.

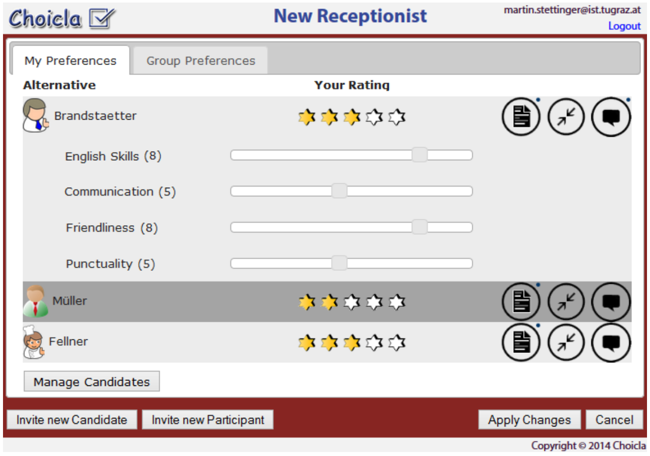

Figure 3: *Choicla*: example of individual ratings. Each user can take a look at the current recommendation and adapt his/her preferences if needed.

To keep the screen understandable, only the line with the aggregated information of a candidate is visible - by clicking on this line, several dimensions including their actual ratings show up for the corresponding candidate (only visible for first candidate in Figure 3). In order to avoid misunderstandings in context of evaluation the sliders of the first candidate are automatically displayed if the screen is loaded. Due to the fact that depending on the advertised job position different assessment criteria are needed, the dimensions on which a candidate can be evaluated can be chosen by the creator of a decision task. If we look at the example in Figure 3 we can see that for the "New Receptionist" the dimensions *English skills*, *Communication*, *Friendliness*, and *Punctuality* are chosen.

In situations where there are candidates for whom not all criteria (dimensions) have been evaluated or there exists a discrepancy between individual evaluations, special markers are used to point out open issues. This approach creates need for closure (see, e.g., [15]), i.e., users are additionally motivated to make the candidate evaluations complete and consistent.

If a candidate should be excluded from the application procedure in early phases (e.g., some criteria are not met), this can be achieved by using the "Manage Candidates" button (a new menu shows up). The early exclusion of an unsuitable candidate supports more clarity since only the "relevant" candidates are displayed.

The tab *Group Preference* presents the current group recommendation, after a predefined number (the threshold) of participants articulated their preferences. This threshold prevents from statistical inferences to the individual preferences of other participants (only in combination with a "private" decision scope - see Section 2). The group recommendation in context of personnel decisions is based on the MAUT-principle (multi-attribute-utility-theory [1]). A group recommendation based on the MAUT-principle (see Formula 3) returns the average value of all individual MAUT values of all participants as group recommendation for one candidate (solution s). A group member's individual MAUT value represents the weighted average of all personal ratings of the dimensions of an alternative. This means that the attribute values are subjective and the weights are fixed which is different in a typical MAUT scenario.

$$MAUT(s) = \sum_{u \in Users} \frac{\sum_{d \in s} eval(u,d) * weight(d)}{|dimensions|} \quad (3)$$

If we look at the individual ratings in Figure 3 we notice the values 8, 5, 8, and 5 for the dimensions. For simplification purposes we assume in our example that all dimensions have the same weight ($w_{d1} = w_{d2} = w_{d3} = w_{d4} = 5$). Due to Formula 3, the individual MAUT value for the actual user of the first alternative is 32.5. To present the evaluation of a solution (candidate) within a five star scale, these values have to be normed.

3.2 Candidates View

All previous described options and screens can only be accessed by the decision makers of the decision task itself and can of course not be seen by the applicants of the job position. During the design phase of a decision task the input fields (e.g., name, age, and application text) which are then visible by the applicants during the application process can be defined. Figure 4 shows the view of an applicant in our running example "New Receptionist".

Figure 4: *Choicla*: example of the entering of application data. Each applicant can insert his/her personal data needed for the advertised job position.

All the added information of the candidates is then prepared and accessible for the decision makers during the assessment phase - see Figure 3. This way of adding solutions to a decision process shifts the burden of entering candidate information by a single person - in most cases a secretary - to the applicants.

4. RELATED & FUTURE WORK

There exist a couple of online tools supporting decision scenarios. Rodriguez et al. [16] describes a system called *Smartocracy*. Smartocracy is a decision support tool which supports the definition of tasks in terms of issues or questions and corresponding solutions. The recommendation (solution selection) is based on exploiting information from an underlying social network which is used to rank alternative solutions. *Dotmocracy*[1] includes a method for collecting and visualizing the preferences of a large group of users. It is related to the idea of participatory decision making – it's major outcome is a graph type visualization of the group-immanent preferences. Doodle[2] is an internet calendar tool with the focus on coordinating appointments. VERN [19] is (very similar to doodle) a tool that supports the identification of meeting times. VERN is based on the idea of unconstrained democracy where individuals are enabled to freely propose alternative dates themselves. A major advantage of *Choicla*[3] compared to these tools is that users of *Choicla* are able to customize their decision processes depending on the application domain and can also focus on specific tasks. Furthermore, the mentioned tools provide no concepts which help to improve the overall quality of group decisions, for example, in terms of integrating explanations, recommendations for groups, and consistency management for user preferences.

Recommendation approaches in the line of *Choicla* are also presented in Sangeetha et al. [8] and Malinowski et al. [10]. Sangeetha et al. [8] introduce recommendation approaches that support people-to-people recommendation (detection of latent relationships between similar users) whereas Malinowski et al. [10] discuss approaches (based on fitness measures) that support the pre-selection of candidates for existing teams (groups). In contrast, *Choicla* focuses on supporting a group decision where parameters such as the fit of a candidate with an existing group are represented in terms of MAUT dimensions.

Our *future work* will focus on the analysis of further application domains for the *Choicla* technologies. Our vision is to make the design (implementation) of group decision tasks as simple and straightforward as possible. The resulting decision task should be easy to handle for users and make group decisions in general more efficient. Our focus will also be on the analysis of decision phenomena within the scope of group decision processes. Phenomena such as decoy effects [5], [18] and anchoring effects [6] have been well studied for single-user cases, however, in group-based decision scenarios no studies have been conducted.

Biases can be induced if a system is open in the sense that new decision alternatives can be added during the decision process. However, such a feature is imperative in cases where all possible decision alternatives are not available from the beginning. The group preferences can also be influenced by the order of the incoming individual preferences due to the fact that the participants of a group will perceive already selected alternatives more attractive than new options [14].

[1] dotmocracy.org.
[2] doodle.com.
[3] www.choicla.com.

If consensus out of discussion is reached in early phases, literature shows that this consensus is cognitive resistant to changes. That means that additional information which is added later in a decision process will be adapted to already defined consensus and due to this it is very unlikely that another alternative is chosen [9]. Such a phenomenon can be explained by the *assimilating effect* which is ascribable to the *dissonance theory* [4]. The *assimilating effect* states that individuals are motivated to reduce psychological incongruity or discrepancy that is very likely to arise if new information is added to a present perception [14]. A high group cohesion intensifies this effect, because within such a group the fear of exclusion is higher (see [9]). Future versions of *Choicla* will reduce this effect by providing a special way of preference visibility which, for example, only shows the preferences of other users for those participants who completed their individual ratings of the alternatives. Another research direction in this context is if such mechanisms can increase the willingness of participants to articulate their real preferences. A further issue for future work is to figure out which group recommendations help to achieve consensus more quickly. Finally, we will develop further group recommendation heuristics which help to achieve a high level of fairness (in the long run).
We want to emphasize that one of our major goals is to make the *Choicla* datasets available to the research community in an anonymized fashion for experimentation purposes.

5. CONCLUSIONS

In this paper we gave a short introduction to *Choicla* which supports the flexible design and execution of different types of group decision tasks with a focus on personnel decisions. With the help of *Choicla* it is possible to achieve more transparent, fair, and structured personnel decisions. Compared to existing group decision support approaches, *Choicla* provides an end user modelling environment which supports an easy development and execution of group decision tasks. We also discussed further research directions which can help to extend the available functionality of the *Choicla* environment.

6. REFERENCES

[1] J. Dyer. Maut - multiattribute utility theory. In *Multiple Criteria Decision Analysis: State of the Art Surveys*, volume 78 of *International Series in Operations Research & Management Science*, pages 265–292. Springer New York, 2005.

[2] A. Felfernig, B. Gula, and E. Teppan. Knowledge-based Recommender Technologies for Marketing and Sales. *International Journal of Pattern Recognition and Artificial Intelligence (IJPRAI)*, 21(2):1–22, 2006.

[3] A. Felfernig, C. Zehentner, G. Ninaus, H. Grabner, W. Maalej, D. Pagano, L. Weninger, and F. Reinfrank. Group decision support for requirements negotiation. In L. Ardissono and T. Kuflik, editors, *Advances in User Modeling*, volume 7138 of *Lecture Notes in Computer Science*, pages 105–116. Springer Berlin Heidelberg, 2012.

[4] L. Festinger. *A Theory of Cognitive Dissonance.* Stanford University Press, June 1957.

[5] J. Huber, J. Payne, and C. Puto. Adding Asymmetrically Dominated Alternatives: Violations of Regularity and the Similarity Hypothesis. *The Journal of Consumer Research*, 9(1):90–98, 1982.

[6] K. Jacowitz and D. Kahneman. Measures of Anchoring in Estimation Tasks. *Personality and Social Psychology Bulletin*, 21(1):1161–1166, 1995.

[7] A. Jameson. More than the sum of its members: challenges for group recommender systems. In *Proceedings of the working conference on Advanced visual interfaces*, AVI '04, pages 48–54, New York, NY, USA, 2004. ACM.

[8] S. Kutty, L. Chen, and R. Nayak. A people-to-people recommendation system using tensor space models. In *Proceedings of the 27th Annual ACM Symposium on Applied Computing*, SAC '12, pages 187–192, New York, NY, USA, 2012. ACM.

[9] E. Lind, L. Kray, and L. Thompson. Primacy effects in justice judgments: Testing predictions from fairness heuristic theory. *Organizational Behavior and Human Decision Processes*, 85(2):189 – 210, 2001.

[10] J. Malinowski, T. Weitzel, and T. Keim. Decision support for team staffing: An automated relational recommendation approach. *Decision Support Systems*, 45(3):429 – 447, 2008. Special Issue Clusters.

[11] J. Masthoff. Group Recommender Systems: Combining Individual Models. *Recommender Systems Handbook*, pages 677–702, 2011.

[12] A. Mojzisch and S. Schulz-Hardt. Knowing other's preferences degrades the quality of group decisions. *Journal of Personality & Social Psychology*, 98(5):794–808, 2010.

[13] E. Molin, H. Oppewal, and H. Timmermans. Modeling Group Preferences Using a Decompositional Preference Approach. *Group Decision and Negotiation*, 6:339–350, 1997.

[14] M. Neale, L. Ross, and J. Curhan. Dynamic Valuation: Preference Changes in the Context of Face-to-face Negotiation. *Journal of Experimental Social Psychology*, 40(2):142–151, 2004.

[15] G. Ninaus, A. Felfernig, M. Stettinger, S. Reiterer, G. Leitner, L. Weninger, and W. Schanil. Intelligent techniques for software requirements engineering. *European Conference on Artificial Intelligence, Prestigious Applications of Intelligent Systems (PAIS)*, to appear 2014.

[16] M. Rodriguez, D. Steinbock, J. Watkins, C. Gershenson, J. Bollen, V. Grey, and B. deGraf. Smartocracy: Social networks for collective decision making. In *HICSS 2007*, page 90, Waikoloa, Big Island, HI, USA, 2007. IEEE.

[17] M. Stettinger, A. Felfernig, G. Ninaus, M. Jeran, S. Reiterer, and G. Leitner. Configuring decision tasks. *Workshop on Configuration, Novi Sad*, pages 17–21, 2014.

[18] E. Teppan and A. Felfernig. Asymmetric dominance- and compromise effects in the financial services domain. In *Commerce and Enterprise Computing, 2009. CEC '09. IEEE Conference on*, pages 57–64, July 2009.

[19] S. Yardi, B. Hill, and S. Chan. VERN: Facilitating Democratic group Decision Making Online. In *International ACM SIGGROUP Conference on Supporting Group Work (GROUP 2005)*, pages 116–119, Sanibel Island, Florida, USA, 2005. ACM.