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Work Experience in PAIS - Concepts, Measurements and Potentials

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Abstract. Process-Aware Information Systems consider various characteristics of resources, such as capabilities, as a driver for allocating task to humans. Work experience has been discussed as a possible variable of history-based allocation, and has been primarily regarded from the perspective of the process. However, work experience has been considered in a limited extend, reducing the perspective on measurements to single aspects such as years of working in an organization, ore amount of performed tasks. Further, the allocation has mainly been oriented towards the best possible fit of humans to the requirements of the task and the process. This contribution is a first step towards an human-centric work experience allocation. It concentrates on the question how experience collected by individuals working with business processes may be measured in PAIS. A collection of work experience measurements at various organizational levels is provided. The measurement collection resulted from a literature review of PAIS theory, selected psychological literature and an qualitative analysis of job offers.

Keywords: Human-centric allocation, work experience

1 Introduction

Process-Aware Information Systems (PAIS), offer various advantages to organizations such as increased quality of output, shorter cycle times and faster feedback. However, PAIS have received criticism as well, mainly referring to their potential to support a too rigid or mechanistic work. Over the last years, there have been several works addressing various aspects of human orientation in PAIS, such as the interaction of automated and human workflows, like BPEL4People [1][3], human interactions [31] [12], flexibility in workflow enactment [10], understandability of business processes [18] [17], and the human-oriented tuning of functionalities in such systems [35], which contributed toward the growing attention on humans and the effects on their performance, satisfaction, and motivation by working with such systems.

Human work experience has been considered particularly in capability-, and history-based allocation as one of the attributes according to which the assignment of humans to tasks were guided. However, work experience has mainly been

considered as a simple count or measurement in PAIS so far, such as the indication of previous work experience in the field in years (capability) or amount of execution tasks (history). However, work experience is more complex than simple measures such as 'more executions = more experience' [36]. In this work we aim to support an understanding of work experience as a complex, multidimensional construct. Our study comprises a literature review of PAIS theory led by the question how resources in PAIS are described, an analysis of job offers that should provide an understanding of the common practice of expressing and measuring work experience in daily life, and an insight into the construct work experience as illustrated in selected psychological theory. Further, this contribution aims at discussing the potentials of work experience as the driver for human-centric allocation in PAIS.

2 Classification and Literature Study

An optimal performance of processes and their tasks is essential for the organizations' competitiveness, however it has been shown that job satisfaction and experience might increase performance as well. Our goal is to support a shift of perspective on the allocation in PAIS from a process-oriented to a human-centric one. In a *process-centric view*, task allocation is oriented according to the best possible fit of humans to task requirements. In a *human-centric view* the center of interest is on humans working with a PAIS. Allocation is led by humans' development and considers individuals' goals of development in an organization and development strategies (such as specialization and generalization). A human-centric allocation should ensure at least a comparable quality of process performance as provided by an process-oriented allocation. We argue, that human-centric allocation can be strongly supported by work experience as a driver for the alignment of tasks to human requirements.

Towards a human-centric allocation we want to provide an understanding of work experience as a complex construct with various facets. The underlying study was guided by the question *whether and how can work experience of humans be measured* (a) in the field of PAIS, e.g., to use this information for the allocation of tasks to humans, (b) in *work psychology* to provide an interdisciplinary view on work experience, and (c) in *daily life* to provide an overview of common practice of describing work experience. Figure 1 illustrates sources that were used to find out more about work experience and its measurements. The source categorizations resulted from applying Brainstorming [22] in a small group of researchers to the topic *Where to find work experience measurements?*

'Work Experience' in Process-Aware Information Systems. A literature review was conducted based on the goal to find out *to what degree work experience of humans has been considered in PAIS theory*, for example, as a supportive factor for the allocation of business process tasks to humans. As a more general question, we also wanted to find out *how individuals have been described in PAIS theory*, and even more general, *how resources have been specified in PAIS theory.*

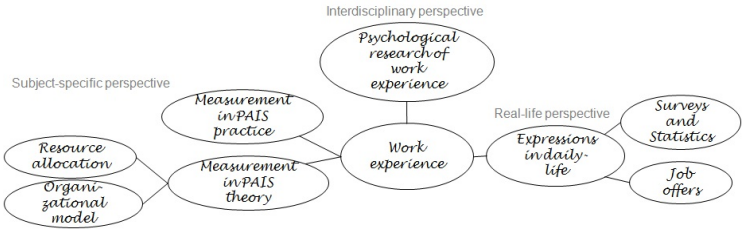

Fig. 1. Sources for work experience measurements as a result of Brainstorming.

'Work Experience' in Daily Life. The labor market in general, and job offers in particular appeared to be an appropriate source for gathering information about work experience as handled in practice. Furthermore, selected surveys and studies were used to illustrate common practice in capturing information about work experience.

'Work Experience' in Psychology. To bring perspectives from other disciplines into our field of view, *psychological research on experience*, and particularly on work experience was considered in this study.

2.1 'Work Experience' in PAIS Literature - A Review

A literature review was conducted to capture information about how *resources* in general, and individuals and their work experience in particular are described in PAIS theory. The literature review was conducted in four phases: broad and deep search, selection of matches, coding, and analysis.

Phase 1: Broad and Deep Search. The broad search was conducted by means of Google Scholar to gather literature from various scientific sources. In the first step, the search was focused on *resources in PAIS*, keeping in mind to find contributions that address humans as 'resources' and 'work experience' as possible descriptor of humans. The selection of the search terms was supported by discussions in a small researcher team and fine-tuned based on the amount and topics of the hits received. The first broad search resulted in 61 hits. In a second step of the broad search, the focus was put on the *organizational perspective in PAIS* and the *resource perspective in PAIS*. As Google Scholar sorts the hits according to their relevance, the first 100 of the 593 hits were considered in the list of results. In a third step the concentration of the search was put on the *organizational model in PAIS*. The search resulted in 82 hits. Figure 2 summarizes the search terms used for the broad and deep search.

The deep search concentrated on selected journals and conferences and was partly conducted via the University's Electronic Journals Library and the library tool ProQuest, and the advanced scholar search of Google Scholar. The deep search resulted in a total of 164 hits (Information Systems: 11 hits, Data and Knowledge Engineering: 11 hits, MIS Quarterly: 7 hits, Business Process

Iteration	Search Terms of the Broad and Deep Search			Hits
	All words	*Exact phrase*	*With at least one of the words*	
Broad Search 1	Resource, allocation, capabilities, experience, workflow	Process aware information systems	Skills, competencies, attitudes	61
Broad Search 2	Organizational, resources, perspective	Process aware information systems	-	100/ 593
Broad Search 3	Organizational, model, workflow	Process aware information systems	Capabilities, skills, competencies, experience	82
Deep search 1	Resource, organizational, perspective	-	Capabilities, skills, competencies, experience	
Deep search 2	Single search: Resource view, resource perspective, resource allocation, organizational perspective, work experience			

Fig. 2. Search terms of the broad search via Google Scholar.

Management Journal: 32 hits, BPM: 31 hits, Caise: 72 hits). To sum up, the broad and deep search resulted in a total of 407 hits.

Phase 2: Selection of the Hits. The text material was further selected according to the criteria text availability, and duplicate reduction. Afterwards, the list of results contained 299 hits (and a total of 4,453,266 words). Keywords were used to automatically highlight relevant text segments in the text material. Examples of keywords were *resource, actor, human, role, privilege*. The highlighted text passages offered a basis to manually categorize contributions according to their relevance to the leading literature review questions.

Phase 3: Coding and Analysis. About hundred contributions (including a total of 51,267 words) included text phrases relevant for the further analysis. These were manually coded by one researcher according to predefined rules, the categories were elaborated inductively. The categories illustrated terms used to describe particularly humans as 'resources' in PAIS. One broad category was *resources*. Text passages that included a description of resources were merged into this category. 642 statements were coded and generalized into 28 groups which were further generalized into six subcategories. Altogether, a total of 50 categories were elaborated in order to capture textual explanations or details to nouns used to describe 'human' resources. Examples of categories were, *role, position, relationship, capability, history, experience, agent, competencies, qualification, skills, attributes, and authorization*. Text phrases could be assigned to more than one category. In the following we use the term *cases* to refer to contributions.

Phase 4: Results. As already assumed before the literature was conducted, resources play a role in various fields of PAIS, such as in task allocation (e.g., the keyword search for *resource allocation* identified 215 counts in 48 cases which are 15.7% of the total 305 cases), organizational modeling (the keyword search for *resource modeling* resulted in 28 counts in 13 cases, 4.3% of the total 305 cases) and security (results of the keyword search for *authorization and role-based access control* were 324 counts in 44 cases, 14,4% of the total 305 cases). Some of the statements differed between *human* and *non-human* resources (53 statements in 18 cases, 5,9% of the total 305 cases).

In the analysis of the selected hundred contributions[1], we categorized statements that explicitly referred to resources. An overview of the results is given

[1] Literature list available under http://cs.univie.ac.at/research/research-groups/workflow-systems-and-technology/project/infproj/1026/

in Figure 3. An example of a statement describing the resource as an entity is the following: '*A resource is a (physical or informational) entity, with which the main concern is whether it is available.*'[7, p. 164]. Further, we were interested in the explanations to the terms *capabilities, features, competencies, skills, qualification and experience* which were partly used to describe resources. We experienced during the analysis, that in most of the contributions the terms used were not further explained, e.g., '*capabilities may include qualifications and skills.*'. It could occur that similar terms were used to express different meanings. Some examples will be presented in the following.

Category	*Subcategories*	*Cases*
RESOURCE_IS	_ENTITY	10
	_ACTOR	1
	_ITEM	1
	_OBJECT	1
	_SERVICE	1
	_IS PAIR OF VALUES	1
RESOURCE_(MAY) HAS	_HAS AUTONOMY LEVEL	1
	_HAS AVAILABILITY STATUS	3
	_HAS CANDIDATES	1
	_HAS JOB	1
	_HAS OWNER	1
	_HAS POSITION	4
	_HAS PRIVILEGES	2
	_HAS RELATIONSHIPS	3
	_HAS ROLE(S)	7
	_HAS BEHAVIOR	2

Category	*Subcategories*	*Cases*
	_HAS CAPABILITIES	9
	_HAS FEATURES	2
	_HAS PARTICULARITIES	2
RESOURCE_(MAY) BELONGSTO	_ORGANIZATION	4
	_ORGANIZATIONAL UNIT	
	_BRANCH	1
	_DIVISION	1
	_TEAM	2
RESOURCE_TYPES	_HUMAN/NON-HUMAN	19
	_OTHER CATEGORIZATIONS	8
RESOURCE_TASK	_IS DOING WORK	11
RESOURCE_ORGANIZATION	RESOURCE DESCRIPTORS	4
	RESOURCE CLASSES	4

Fig. 3. Categorization of text phrases explicitly referring to resources.

The term *capabilities* in connection to references was mentioned 40 times in 18 cases (18% of the selected 100 contributions).*Capabilities* were partly understood as a synonym of *attributes* ('*capabilities or attributes [...]*' [29, p. 221][28, p. 3][30, p. 172]). They were also described as *individual characteristics*[30, p. 185], *qualities*[30, p. 267], or *characteristics of interest*[6, p. 57].Furthermore, they were considered as including *qualifications* (5% of the cases), *skills* (9% of the cases), *job-related and personal attributes*, which were further distinguished into *responsibilities* and *work experience* (3% of the cases), as well as *non-functional properties* (1% of the cases). Capabilities were also described as being a *direct property* of the resource (2% of the cases), may be expressed in terms of *values*, (4% of the cases) and *recorded* as part of the organizational model (1% of the case). Capabilities were also mentioned to be considered in the *allocation* process to support a finer allocation (7% of the cases).

The use and the textual description for the term *feature* in order to describe resources was found in just a few contributions: '*which further describe specific characteristics that they [individual resources] may possess that could be of interest when allocating work items.*' [28, p. 4][29, p. 221].

The term *competencies* seemed to be understood in two different ways: in some contributions competencies were described as '*the ability to perform a certain task*' (2 cases) whereas others explained competencies as '*[attributes] that depend on the position the actor occupies in a given organization*' (2 cases).

Competencies in the sense of *abilities* (2 cases) referred to *understanding, improving* e.g., processes and might be understood as *intrinsic attributes correlated with performance*[8]. Competencies were argued to have a strong relevance for the organization, job and task to be performed (1 case), and might be supported by *training* (1 case). Competencies were explained to reflect a combination of *knowledge, skills and attitudes* gained through *experience, study, practice and repeated application of knowledge* ([8] according to [4]).

Skills were considered as *capabilities* as mentioned above and were understood as the *measurable ability that must be practiced or demonstrated* by a person. Skills may be used to create and to group into roles (skills necessary to perform particular tasks in a business) (6 cases).

Another term mentioned was *qualifications*. Qualifications were explained as '*expressed as the roles they [human and non-human resources in a business] can fulfill.*'in [11, p. 51]. Qualifications as *directly connected* to resources, such as 'language skills', were mentioned in [19, p. 148]. [30] distinguish among qualifications (specified as individual characteristics) and abilities to undertake certain tasks (such as *licenses held, trade certifications*[30, p. 185].

Experience was understood in several ways, such as *who has the most experience with this type of work item*[30, p. 187], *who has had the least numbers of failures when tacking similar tasks* [28, p. 19][30], or was expressed as *familiarity* (how familiar is a resource with performing a work item [14]. As a measurement, the *number of sibling work items the resource has already performed*, including the best past execution were mentioned. [8] describes an *experience index calculation* which was divided into 3 steps: the level of activity performance of each performer was summed for each degree of activities, then each sum was multiplied per a coefficient/weight which expressed the complexity degree and the sum of all these multiplications was finally normalized by using a value associated to an expert scale (discipline advisor - very expert specialist - expert specialist - senior specialist - basic specialist)[8, p.307]. A more simple experience measure was proposed by [36], indicating that *more executions of an activity = more experience*. Other statements referring to work experience addressed the work experience measurement in years, e.g., 'How many years have you been in the IS profession'[33]. As a specification of individual characteristics,[30] mentioned *previous jobs*, which can also be seen as previous work experience. [20] mentioned *the amount of work done in a PAIS*, and *the time worked with the PAIS* in the context of internal validity of their study, however these factors may also be considered as measurements for work experience. History-based allocation was mentioned as a resource pattern that provide information that may be seen as analogue to human experience [28].

Lessons Learned. The results of the literature review of PAIS theory indicated no evidence that a human-centric allocation based on work experience has already been proposed in the field of resource allocation in PAIS. Further we could identify a mix of terms used for describing characteristics of humans considered as resources in PAIS. The various terms seem to be used intuitively rather than following a clear and separated understanding of the respective terms. We rec-

ognized that often terms were just mentioned without further explaining their understanding by the author and offered a basis for different interpretations by the reader. Further, graphical illustrations were not described and explained which aggravated finding a common understanding of terms. We focused on explicit explanations of the terms in textual form which reduced the relevant text material to a minimum of the initially found literature.

2.2 'Work Experience' in Daily Life

In order to find out more about 'work experience', e.g., how it is expressed and proven in daily life, a qualitative content analysis of job offers was conducted. The job offers were collected from the online career network *jobpilot.de*. A total of 83 job offers (without duplicates) were selected which resulted from searching for *'permanent positions','career level: experienced', 'worldwide job offers', 'occupational fields: strategic management, information technology', all specifications, all branches, all regions, 'job offers of the last 4 weeks'*. The number of employers could not be identified, as several job offers were announced in an anonymous way via recruitment agencies. Altogether, the material for analysis comprised 24,516 words. Categories were elaborated inductively and are illustrated as results of the qualitative analysis of job offers in Figure 4.

CAT.	SUB-CATEGORIES	COUNT*	EXPAMPLES
WORK EXPERIENCE	Experience in the field	43,4% (53/ 36)	'To be qualified for this role, this individual should have over 7 years of experience within development and architecture.'
	Hands-on experience	56,6% (77/ 47)	2-3 years of experience with C# and ASP.NET and the SDLC.'
	Industry/ Employment experie	16,9% (14/ 14)	'They are looking for an engineer who is CCNA-CCNP level with 3-5 years of industry experience.'
	Functional experience	8,4% (7/ 7)	'The ideal candidate will be enthusiastic and ambitious and have a proven field based management experience within a retail environment either working as an area manager, regional manager, multi site manager or area sales manager.'
	Generic experience	7,2% (7/ 6)	'This individual should also have lead experience.' 'Experience working in cross application teams...'
PROOF	Time (years)	43,4% (45/ 36)	'10-12+ years experience in relevant software or internet service industry with a service operational background.'
	Track record	22,9% (20/ 19)	'1 year project management experience with digital agency, a proven track record in delivering various digital advertising projects...'
	Work knowledge and skills	80,7% (110/ 67)	'Experience in writing or executing test cases.'

* First row: % of cases (job offers)
Second row: count of the statement / number of job offers where statement was found

Fig. 4. Categories of 'work experience' resulting from job offer content analysis.

The qualitative content analysis included the search and coding of statements that referred to *experience*. Five sub-categories were elaborated to reflect the meaning of *experience* in the statements. Statements, that referred to experience in a broader area, such as 'internet technologies' were subsumed to *experience in the field*. The sub-category *hands-on experience* included statements that focused on experience from practicing, e.g., developing software in Java. Other statements referred to past employment experience which were subsumed into the subcategory *industry/ employment experience*. More specific statements which included explicit functions or roles were aggregated into the subcategory *functional experience*. The final subcategory was *generic experience* which captured statements referring to generic, not subject-specific, experiences, e.g., 'experience with leadership and budget responsibilities'. The second category focused on the *proof of work experience*. Three subcategories were derived from

the underlying job offer text material: *time* (typically expressed in years), *track record* (including records such as projects, employers and functions), and *work knowledge and skills*. Many of the statements referred to work knowledge and skills (e.g., 'experience working with version control systems', financial experience'). All these statements were summed up to one subcategory as they had one aspect in common: independent of the further supportive records - finally it is the individual who needs to proof the experience, e.g., by demonstration.

The qualitative content analysis of selected job offers helped us to understand, that there seemed to be different perspectives on work experience and that work experience cannot be captured in its complexity by one simple measure. The search in surveys and scales supported this perception. Traditional measurements of work experience in, for example, earning studies were to deduct the years of completed schooling from the individuals' age (in years) at the start of a specific period in order to receive the years of accumulated experience. Further work experience measurements have been, for example, the time spent in the labor force, time employed, and time since school graduation as mentioned above [23]. In addition to the general perspective on work experience, there were also measurements of hands-on experiences, for example in business process modeling studies which noticed modeling experiences (e.g., levels such as novices and experts) as a factor influencing, e.g., task performance [25]. Often the participants of the surveys were asked to self-assess their level of experience, to express their modeling experience in time (e.g., number of years experience in process modeling overall, number of months experience in a particular process modeling grammar), or in the number of process models created [26].

2.3 'Work Experience' in Psychology - An Initial Touch

In the following section, our intention was not to provide a holistic insight into psychology research on work experience but rather to initially sense the construct 'work experience' as discussed in psychology. Considered were contributions of the Journal 'Personnel Psychology' including research around people at work. A search via ProQuest by using the search terms 'work experience' resulted in 6 hits. In the following we will summarize these contributions by illustrating the model of work experience as proposed by [32] (based on [24]), and providing an overview of work experience components, as well as quantitative and qualitative work experience measurements.

Understanding of work experience. [32] suggest to consider work experience as a *'multidimensional, multilevel, and temporarily dynamic construct'*[32, p. 326] and describe a model of work experience that includes three major components of work experience: the quantitative, qualitative, and the interaction component. The *quantitative component* includes in general two measurement methods, time-based and amount-based measurements. Explicit quantitative measurements are (citations were taken from [24][32]): time on a task [24], time on the job/position (job tenure) (e.g.,[15][5]), time spend in an organization (organizational tenure) (e.g., [16]), number of times a task has been performed (activity level, task

frequency) (e.g., [13][34][9]), number of jobs held in an organization [24][32], and number of employers. The advantage of the amount measurements (e.g., number of times a task has been performed) is that they imply information about qualities that affect work experience, such as the opportunity to perform and practice particular tasks. The *qualitative component* of work experience includes aspects (such as variety, challenge, and complexity) that will differ in their relevance for different domains. Explicit qualitative measurements are: variety of tasks, breadth (number of different tasks), and responsibilities performed in a job, types of challenges encountered in an assignment, task type (difficulty/criticality/complexity of the task performed)[24], job complexity [24], type of organization [24], opportunities to develop new knowledge and skills through training (see also [32]), working with a highly supportive mentor (see also [32]), recency of tasks [9], and supervisory tasks [9]. The *interaction component* considers the interaction between the qualitative and quantitative components of work experience. The interaction may be reflected in 'density' which intends to capture the level of intensity of experiences. A scenario that illustrates a high-density experience is an individual in a one year assignment who faces many challenging situations while another individual in a similar assignment faces just a few challenging conditions. Another interaction component is 'timing'. How an individual is influenced by an experience depends on when the experience occurs during a career. Experiences can be sequenced in ways that maximize motivational and performance outcomes [32, p. 330]. The *level of of specificity* determines how specific is the measure of experience in question. Experience measurement can be specified in different levels such as the task-, job-, and organizational level [24], and the work group level (measurements may be the number of different work groups and the type of teams such as cross-functional problem-solving teams)[32, p. 330].

Shaping work experience. Work experience can be shaped by, for example, contextual and individual factors which also *'influence how experience translates into work-related knowledge, skills and motivation and important organizational outcomes such as job performance'*[32, p. 322]. Contextual factors may rang from macro to micro ones, such as societal demographic trends and job characteristics. Some more *micro-level contextual factors influencing work experience* are: performance management and feedback systems [32], opportunities for skills updating and training and supervision [32], work group climate, and work characteristics. *Individual factors* influencing work experience may be personal characteristics such as [32] an individual's ability, likeability, motivation, and self-efficacy. Contextual and individual factors also affect what is extracted from work experiences. *Learning from experiences* requires the reflection and the individual's desire to learn, as well as an environment that provides the opportunities for reflection and learning.

Work experience as source of career development and training. Research in the area of management development has identified different types of work experience that motivate learning and development, such as work transitions (e.g.,

taking on a new assignment), task-related job demands (e.g., implementing changes), and job demands from obstacles (e.g., lack of adequate resources). These insights have been led by the theory that on-the-job work experiences are the primary source of individual career development and learning rather than formal training.

Experience-building strategies. Experience-building strategies as discussed in [32] may be: access to special work assignments, such as working on project teams in order to develop teamwork, leadership, and change management skills, staffing practices where assignments are ordered in such ways to build knowledge and skills sets, structured sequencing of work roles to foster development based on cumulative work experience. However, the different career practices need to ensure that new experiences closely match prior experiences as otherwise latter will not facilitate subsequent learning and performance. Furthermore, it needs to be considered that a greater breadth of tasks and challenges experienced may sacrifice the depth in the development of expertise.

Outcomes of work experience. Work experience *'leads to the development of knowledge and skills, motivation, and attitudes and values that factor into performance and other organization-valued outcomes'*[32, p. 334]. For example, the number of times a task has been performed can enhance proficiency by honing skills through practice. The length of time in a job has a strong influence on performance through the development of job knowledge and skills. Furthermore, experiences that provide a high level of autonomy can create an increase in intrinsic values and enhance emotional well-being. The outcomes of work experience can be specified in direct and indirect outcomes[32]. Direct outcomes may be increased work knowledge and skills[32], motivation [32], and work-related values and attitudes [32]. Indirect outcomes of work experience may be performance [32], and participation in developmental activities [32].

3 'Work Experience' as Critical Factor in PAIS

According to the psychological theory there is a recognizable correlation between work experience and job performance. From our point of view, humans as critical 'resources' in PAIS have received too little attention in PAIS theory so far. The integration of work experience and its measurements into PAIS could be considered in different ways such as (a) from the individuals' perspective (*Where did the individual collected experiences and how?*, (b) in the sense of *how do and did individuals experience the work on the tasks allocated to them?*, and (c) from the perspective of the process (*What did the process experienced with the resources working on the task and how these experiences be expressed?*. The consideration of work experience from the individuals' perspective can be supported by quantitative and qualitative work experience measurements as discussed in Section 2.3. All three levels of specificity (task-, position/job-, and organizational-level) may be relevant for the experience measurement. Figure 5 offers an overview of work

experience measurements to measure individuals' work experience in PAIS. Figure 5 is based on [24, p.892][32] and specified for PAIS according to the findings of the literature review and job offer analysis described in the previous sections.

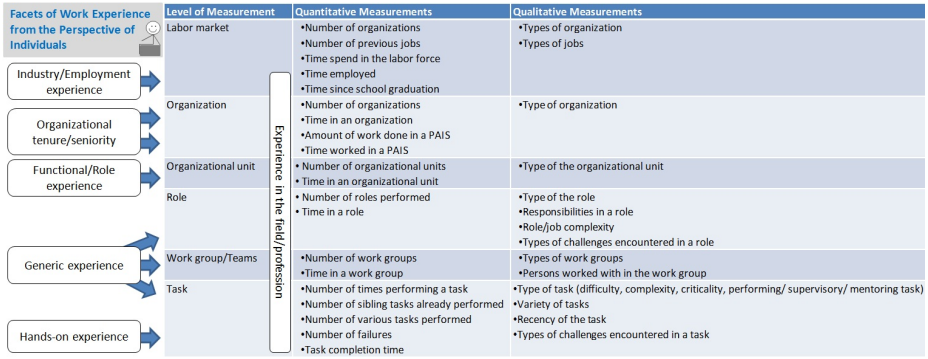

Fig. 5. Proposed PAIS work experience measurements for individuals.

Another aspect of measuring could be the quality of work experience. The hypothesis is that how work is experienced (e.g., stressful, pleasant, challenging, dull) also affects personal and organizational outcomes [2, 21]. Qualitative measurements may be placed on three different levels of time [2, p. 532]: (a) immediately, asking individuals what they are doing now and how they feel about it; (b) short-termed, asking individuals after a short period of time about their experiences, e.g., after a working day; (c) long-termed, asking individuals to recollect or reconstruct experience over an extended period of time.

Finally, a process may also collect experiences with the resources (typically known as *history-based allocation*). There are several types of measurements of process experience extracted from process history, and most of them refer to the task level. Measurement types are *number, amount*, and *resource*. Time and amount measurements may be, for example, the number of task failures/successful executions, task completion time (e.g., best, average, lowest). Measurements that refer to the resources performing tasks may as well include time and amount measurements which may then be ranked among resources (e.g., resource with the shortest turnaround time for the task, least recently execution of time, resources with the lowest number of failures in performing the task). Of course, such measurements seem to be critical concerning privacy of humans working in a PAIS and need to be handled in an appropriate manner.

4 Discussion

'Work experience'-based Allocation in PAIS. 'Work experience'-based allocation can be understood as a combination of capability-based [28] and history-based

allocation [28]. In order to capture all the facets of work experience as considered in psychological research, static and dynamic information needs to be gathered. We understand *static* information as information that is once determined and remains mainly unchanged. Updates may be performed in a medium- or long term. This information is the typical information of 'work experience' as described in the capability-based allocation resource pattern [28], such as number of employers, type of employers, or previous work experience (e.g., 10 years experience in Airbus servicing [28, p. 17]). *Dynamic* information is considered as information that needs to be repeatedly updated as it refers to the previous execution history of the human who is considered as the 'resource' in PAIS. Such dynamic information may exist at different levels of work experience measurements(compare with Figure 5) and captures information about, for example, time in and type of a work group in which the human performed (team level). The role-, and organizational unit-level capture information that may not be changed in short-term, nevertheless this information should as well be updated and considered in terms of 'work experience' for the allocation of tasks to individuals (e.g., as tenure/seniority within the organization). The dynamic information collection refers to the history-based allocation resource pattern [28].

In order to be able to consider the static and dynamic information about work experience for allocating tasks to humans in PAIS, the details captured and maintained for 'human resources' need to be extended, or the information from previous execution history of humans needs to be extracted from workflow logs to use it in the allocation process [28, p. 19]. Referring to the latter, it needs to be determined what information has to be logged whereby the design of the process logs will be affected. A concrete description and guideline for work experience-based allocation and the illustration of log design that captures work experience will be presented in future work. Work experience-based allocation has a potential to support various allocation best practices as presented in [27], such as case manager, case assignment, customer teams, flexible assignment and specialist-generalist assignment. For example, information about work experience can be used to identify the most experienced case manager in the organization in order to, e.g., guide critical cases or escalations. Customer teams may be composed based on the individuals' work experience. Furthermore, work experience may be used as a factor for identifying specialists and generalist, but also to lead individuals to a particular specialization or generalization level. Work experience can not only be used to identify individuals who have a high level of work experience, but also to find these individuals who need to build up work experience (e.g., novices). These individuals can be supported by, for example, providing a mentor for a task or a case, offering 'how-to' video streams, or exemplary output of the activity as a guideline. Highly experienced individuals may be suggested as mentors, or as experts in critical process instances. Future research will address human-centric functionalities in PAIS which are based on work experience.

A challenge of considering work experience information may be the trade off between work experience transparency and the privacy of the users. To deal

with this data in a sensitive way, appropriate access control need to be considered (e.g., restricted access to anonymised data).

Benefit of Work Experience Information from PAIS for Daily Life. Information of work experience which we suggest to be gathered and used in PAIS for the allocation of tasks to humans may provide also benefits from a more general point of view. The information of an individual's work experiences may be considered and prepared as a portfolio providing the individual with a detailed documentation of his or her work at the particular employer. This portfolio may be understood as a detailed track record, or in other words, a kind of proof of work experience collected in an organization (compare with Figure 4). Furthermore, the transparency of work experience of humans in the organization may serve the organization and the individuals as a information basis on which decisions concerning formal learning and training for specifying or broadening individuals' knowledge, skills and competencies may be taken.

Collecting Data for Work Experience Research. There are several ways of looking at how 'work experience' can be considered in PAIS and to what outcomes it should lead. In our point of view PAIS seem to have enormous potentials to provide a fruitful context for collecting data critical to find out more about the construct 'work experience'. In general, PAIS may be used to find out under which conditions experience leads to a desired outcome.

5 Conclusion

The main goal of this work was to focus on work experience from various perspectives to perceive the construct work experience with its various facets, to bring some transparency to its measurements, and to discuss potentials its potentials as a possible individual attribute in PAIS. A literature review was conducted in PAIS theory which concentrated on the descriptions of resources, in particular human 'resources' in the context of PAIS. The text material analyzed partly lacked term explanations used to describe resources, particularly when individual attributes directly connected to a particular person (such as qualifications, skills, competencies, experiences) were mentioned. The woolly manner of expressions of individual attributes indicates a necessity for clarification including explanation and distinction between the terms and attributes used. The analysis of job offers showed that there were several ways to express and measure work experience in daily life. Various facets of work experience were as well reflected in the multidimensional understanding of work experience as illustrated in psychological literature. The result of the study was a collection of work experience measurement that can be considered in PAIS. The better understanding of work experience and the collection of work experience measurements for PAIS provide the basic step for further work. The potentials of work experience as one of the individual attributes describing and considering humans in PAIS are particularly seen in a finer and more value adding allocation of humans to tasks from the

perspective of the individual (e.g., allocation leaded by the goal to build-up experiences). This contribution can be considered as a first step towards providing a holistic solution of integrating work experience into PAIS.

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