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A Systematic Literature Review of Crowdsourcing Research from a Human Resource Management Perspective

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Abstract

From a human resource management perspective I review the crowdsourcing literature included in top peer-reviewed journals and conferences, and build up a comprehensive picture. Based on this I identify empirical and design-oriented research needs.

1. Introduction

This work is about crowdsourcing from a human resource management (HRM) perspective. HRM is an organizational function fostering employee performance in service of their employer's objectives and includes job design and analysis, workforce planning, recruitment, selection, training and development, performance management, compensation, and legal issues [1]. "Crowdsourcing" as originally introduced by Howe [2] is "...a sourcing model in which organizations use predominantly advanced internet technologies to harness the efforts of a virtual crowd to perform specific organizational tasks" [3, p. 3]. Regarding the most significant advantages of using crowdsourcing the literature generally discussed costs [4]–[6], speed [4,6], quality [4], flexibility [7], scalability [6], and diversity [4]. The crowdsourcing concept itself developed from a more amateur/hobbyist label to a serious, widely distributed problem-solving approach for professionals [8,9]. Meanwhile, there is no doubt that crowdsourcing is a promising approach for both enterprises and crowdworkers, e.g. [10,11], as the first successful crowdsourcing systems including marketplaces (e.g. Amazon Mechanical Turk (mTurk) and service providers (e.g. Microtask, CrowdFlower) have been developed. A crowdsourcing system (**CS**) "...enlists a crowd of humans to help solve a problem defined by the system owners" [12, p. 87].

Scholars have tried to empirically understand the emerging crowdsourcing phenomena mainly by investigations of practical crowdsourcing applications and case studies [9,13]–[27], crowdsourcing experiments [4,6,10,28]–[31], and surveys/interviews [24, 32]. In addition, scholars fostered theoretical understanding primarily by analytical/conceptional [5,12,33] and technological/design-oriented [11,34]–[42] contributions. As a result, specific important crowdsourcing challenges have been carved out (i.e. task-design [27,43], motivation problems [6,9,27,44]–[46] and incentive systems [11,15,46,47], task-routing and task-coordination [11,35,37,40], quality control of work results [4,11,31,36,42,43,46], and task-aggregation [12, 21,43]. These specific contributions enhanced our understanding of crowdsourcing details – but not of the whole. Comprehensive overviews guiding crowdsourcing research are still widely missing, with three exceptions: Pedersen et al. [48] reviewed from 01/2006 to 01/2012 75 Crowdsourcing-related papers from a input-process-output model perspective. As a main result they open the question of what drives potential users to take part in crowdsourcing. Zhao and Zhu [46] provided summary reviews of 55 crowdsourcing papers from 2006-2011 concerning theoretical foundations, research methods, research foci, and identified three broader future research directions: the participant's perspective (motivation, behavior), the organization's perspective (adoption, implementation/governance, quality/evaluation), and the system's perspective (incentive mechanisms, technology issues). Following [46] I focus on the organization's perspective as one of the three identified broader research directions. However, in contrast to [46] I argue from an organization theory point of view that the organization's perspective include both the coordination problem and the motivation problem (see [49,50]). Organization theory suggests solving the motivation (and behavior) problem of workers by adequate incentive mechanisms [51] and the coordination problem by establishing suitable organization structures and processes [49,50,52]. Between the coordination problem and the motivation problem there are empirically confirmed connections [53,54]

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since established organization structures and processes influence a worker's motivation (e.g. status motive) and organizational incentive mechanisms influence the coordination problem (e.g. willingness of responsibility). Therewith – in contrast to [46] – a successful analysis of the organization's perspective has to include behavioral issues and incentive mechanisms as a part of the organizational motivation problem. The other existing serious work guiding research needs stems from an organization's perspective: Aguinis and Lawal [1] highlighted the so-called "eLancing" (crowdsourcing) phenomena from a HRM point of view and formulated for each of the eight HRM core areas research questions which should guide further research. I use these HRM core areas and the associated research questions to analyze existing crowdsourcing literature. As [1] showed, the HRM perspective seems to be a promising view to enhance our theoretical understanding in crowdsourcing research. HRM is an enterprise key function directly addressing the coordination problem (by job design and analysis, workforce planning, and recruitment and selection, training) and the motivation problem (by employment contract design, performance management, leadership, and compensation). That is why – following the research call of [46] – in this article I review all existing "substantial" scientific crowdsourcing work related to the HRM perspective and build up a comprehensive literature review. Based on this review I identify empirical and design-oriented research needs to guide future research for both speeding up the theoretical progress of understanding crowdsourcing phenomena and fostering the adaption of the global workforce to enterprises by crowdsourcing.

RQ: What are the research needs in order to speed up the theoretical progress of understanding crowdsourcing phenomena and fostering the adaption of the global workforce to enterprises by crowdsourcing?

The paper is organized as follows: In section 2 I present the research methodology. Section 3 contains the comprehensive review including the particular empirical and design-oriented research needs. In section 4 a compacted framework guiding future research will be shown on the basis of a summarized discussion of the respective research needs. Finally, the conclusion including research limitations and future work is found in section 5.

2. Methodology

On the basis of a systematic literature analysis identifying HRM-related crowdsourcing publications, respective research requirements to foster crowdsourcing studies will be identified. These needs will be formulated in the form of particular propositions and technology-/ design-oriented calls (*highlighted with italic type*). On that basis a framework guiding future crowdsourcing research will be shown. Based on the research agenda of [1] I analyzed (selective coding) the existing crowdsourcing research from the perspective of the core HRM areas: job design and analysis, workforce planning, recruitment, selection, training and development, performance management, compensation, and legal issues. Due to the importance of (e-)leadership especially in virtual teams [55] I have added the leadership function to my investigation.

2.1. Literature search strategy

In order to extract relevant research from the published literature, a systematic literature search capturing crowdsourcing work from the beginning of 2006 until 15/03/2014 was undertaken. 15 meta-databases (i.e. SpringerLink, ScienceDirect, JSTOR, INFORMS Pub, WileyOnline, IEEEXplore DL, ACM DL, Swets Inf. Serv., Palgrave Macmillan Pub, Taylor & Francis Online, Emerald Online, Cambridge Journals, SAGE, AIS Electronic Library, and Mary Ann Liebert) as well as the Journal of MIS (JMIS) were searched, resulting in over 400 articles that met the inclusion criteria (abstract or title or keywords contains "crowdsource", "crowdsourcing", "crowd sourcing", "crowdsourced", "crowdsourcer", or "crowdsources".). In addition, a forward and backward search was performed (cf. [56]).

2.2. Criteria for study identification

To ensure the inclusion of only "substantial" scientific crowdsourcing work in this review I only considered international peer-reviewed publications (journal articles and transactions) with completed research work. For reasons of quality, poster sessions, editorials, interviews, commentaries, conference proceedings (with the exception of ICIS, HICSS, ECIS, AMCIS), and RIP papers were not included. After reviewing 217 articles included in top journals and conferences, 109 articles were identified to be relevant within the HRM domain (considerably addresses at least one HRM area). The identification was based on a manual decision by four reviewers at a reliability of 98.9%.

3. Crowdsourcing research from a HRM perspective

3.1. Job design and analysis

Following the standard organizational literature [49, 50], the type of job that must be done can be roughly

separated into (a) routine tasks and (b) complex and creative tasks. Crowdsourcing literature also already distinguish between these both job types [3,57].

3.1.1. Complex and creative tasks. Most of the crowdsourcing publications that pay attention to complex and creative tasks are related to idea generation [14,58,59], competition [19,26], and evaluation by the crowd [4,30].

3.1.2. Routine tasks. It is notable that most crowdsourcing experts had found that "stand-alone tasks" and tasks with a "clear definition" are best suited for crowdsourcing [43]. To date, for every crowdsourcing project a specific domain knowledge and a "well-developed problem statement" is needed [43].

3.1.3. Analysis-synthesis and coordination problem. Specific crowdsourcing literature emphasizes the "analysis-synthesis concept" as a key concept for successfully applying CS in enterprises, e.g. [30,60]–[62]. This concept comprises of (a) the decomposition of the main task (goal) into sub-tasks delegable to people and (b) the synthesis of sub-tasks results in order to reach the goal of the whole organization [63]. Related first successful trials implementing the analysis-synthesis concept have been undertaken: [61] showed through a collaborative music-making example the concept of a (spectral) decomposition of the main task (here: an original recording) into several micro tasks which were offered to the crowd. The completed micro tasks (here: self-interpreted interpretations) were gathered and re-synthesized into the original corpus. [60] reported from two successfully applied systems (the word processor `Soylent` and the proofreading system `Adrenaline`) that decompose complex tasks into a simpler one and re-synthesized the micro tasks. The analysis-synthesis concept of [62] for film and TV data is based on a metadata schema with an XML format sequencing parts of the film.

Despite the first crowdsourcing successes it is remarkable that all the existing projects deal with the analysis-synthesis problem in a sequential manner: The micro tasks were separated and synthesized more or less in series. E.g., [21] empirically showed that the aggregation of tasks at different quality levels is a standing problem in crowdsourcing research. However, considering the producer/consumer relationships, the simultaneity constraints, and the task/sub-task dependencies of realistic organization processes [64], the current state of the solution of the underlying "coordination problem" [52] by crowdsourcing technologies still fails. The coordination problem refers to the management of "dependencies between activities" [64, p. 90]. In addition, with the constantly recurring idea of flexibly connecting billions of computational agents, web services, and humans, the coordination problem contains human-computer/agent interaction issues as a interdisciplinary challenge. Thus, I *call for a strong interdisciplinary study of the underlying coordination problem in crowdsourcing activities* following [64].

3.2. Workforce planning

The idea of crowdsourcing contains a flexible on-demand working model [2,3]. And that is why HRM work assumed that "workforce's size and other characteristics ebbs and flows with the amount and types of tasks that need to be completed at any particular point in time" [1, p. 13]. Nevertheless, at this time, given the state of crowdsourcing research, it is too naive to think that successful crowdsourcing do not need a long-term strategic planning of the workforce at all: As [65] emphasized, crowdsourcing is consistent with the open innovation paradigm. Thus – from a strategic point of view – it must be clear that the "crowd is being asked to share its knowledge as users to improve its own experience" [65]. Therewith intellectual property (IP) will probably drain. Picking up the IP problem, the layered model from [66] could be an approach to help solve it. [66] discussed crowdsourcing within a B2B context and proposed a layered model differentiating employees, trusted and/or pre-qualified partners, and the general crowd. [67] combined with the so-called `ExpertLens` approach exclusive expert groups with selected crowds. Likewise the analysis-synthesis challenges from section 3.1.3 can be viewed from a coordination problem perspective, while the workforce planning challenges are obviously rooted in coordination problems. Following [68], planning in general can be viewed as part of the coordination problem. Thus, *future CS research from the coordination problem perspective* seems to be very promising.

3.3. Recruitment including selection

When recruiting suitable employees, HRM authors emphasized the key roles of the person-organization (P-O) fit, the person-group (P-G) fit, and the person-job (P-J) fit [69]–[71] since meta-analyses showed significant positive correlations between high scores of these fits and job performance, job satisfaction, organizational commitment, and employee turnover.

3.3.1. Person-organization fit. Focusing on these fits in more detail, crowdsourcing literature has empirically

begun to investigate the roles of climate and culture in organizations using crowdsourcing as one important part of the P-O fit: On the empirical basis of a OSRAM case study, [16] revealed the key role of a climate for cooperation on the firm level as a pre-condition for successful crowdsourcing. The case study of a Fortune 500 organization by [17] also showed the critical role of a successful cultural adaptation for collaboration effectiveness. The empirical investigation of crowdsourcing success factors by [72] revealed the importance of learning "unwritten" rules when new crowdworkers join the project. To summarize, the critical roles of an organizational's climate and culture seems to be confirmed. Nevertheless, future work following [71] but crowdsourcing-related could deepen our understanding in *weighting and combining P-O fit evaluation criteria*. In addition, since climate and culture are very stable phenomena, the open questions during recruiting decisions are: *How to evaluate the P-O fit and how to identify the best matching candidates? – preferably automatically*.

3.3.2. Person-group fit. Concerning the P-G fit, only one suitable crowdsourcing investigation exists: A critical analysis of facilities following the 2010 Haitian earthquake by [20] showed that the most volume, speed and accuracy in information processing of 80,000 text messages – computed in a real-time humanitarian crowdsourcing initiative – was done by Haitian nationals. Technology did not play any significant role. Social ties and personal involvement were the key factors. Despite the problem of a lone investigation at this time, it has to be acknowledged that we have little empirical evidence for the critical role of the P-G fit in a manner that real social ties are very important. This result is in line with prior general HRM works. That is why further empirical investigations focusing on the P-G fit on crowdsourcing as well as related technological works, e.g. following [73] but crowdsourcing-related, are needed. Thus I formulate:

P_1: The P-G fit is positively associated with the individual and group-level outcomes in CS.

3.3.3. Person-job fit. With the P-J fit in mind I focused on an individual level [74] and found a few empirical publications publications as well as initial technological solutions: The empirical investigation of [75] showed that CS users generally only have small differences in the five big personality traits compared to the general population. It can be concluded that the self-selection effect of crowdsourcing participants is of little importance. With it, the "cognitive diversity" of the crowd can be employed by profiling the user's personality [34,69] since personality traits significantly influence the person's behavior (beside P-J fit cf. P-G and P-O fits). In terms of interests/preferences, [22] found systematic differences between crowdworkers from the USA and India, probably explained by cultural differences between both countries (e.g. [76]). All in all it can be concluded that the empirical base of the P-J fit is too small at this time. Further empirical evidence is needed such as the one that [77] plans to carry out by directly assessing the P-J fit on crowdsourcing using an empirical analysis (research-in-progress state). I formulate:

P_2: The P-J fit is positively associated with the individual and group-level outcomes in CS.

Besides the (small) empirical base, initial conceptual and design-oriented work on the P-J fit has been carried out: [78] began to conceptually address the P-J fit by identifying typical matching patterns based on specific job needs. Most of the CS established some P-J fit selection features (e.g. variations of the Captcha approach, some rating/reputation/evaluation mechanisms such as mTurk's approval rate) [4,30]. In addition, qualification tests were used to select suitable workers. Some CS provide features for blocking workers. In addition to the established practical features, first more sophisticated skill-matching [39] and auction based [11] P-J fit mechanisms have been developed. Considering the evaluation results, these initial solutions seem to be very promising for further investigations. That is why future design-oriented work should *extend the functionality of mechanisms for matching and coordination between the potential crowdworker (applicant) and the offered micro task*.

3.4. Training and development

HR development is one of the key HRM functions and responsible for the improvement of the worker's skills, knowledge, and abilities [1]. Although [43] emphasized the importance of training the crowdworkers as a result of an empirical study at a large multinational technology firm with high crowdsourcing experience, only few HR development-related crowdsourcing solutions exist: The MobileWorks architecture reassigned those crowdworkers whose overall accuracy was below a certain level to training tasks until their accuracy improved [35]. The human-centric runtime framework for crowdsourcing proposed by [37] includes a expert ranking component to maintain skill evolvement. The auction-based model by [11] for the assignment of crowdworkers to micro tasks has a strong connection to the continuous improvement of a worker's skill level. With the exception of [43] all other existing

development-related crowdsourcing studies are design-oriented. There is a lack of empirical investigations concerning training and development issues on crowdsourcing. Due to the importance of HR development in general [1] and in particular on CS [43] I formulate:

P_3: Training and development investments by the CS are positively associated with the individual and group-level outcomes in CS.

3.5. Performance management

Performance management covers measuring and developing the effort of both individuals and groups [1].

3.5.1. Measuring individual outcomes. To assess individual outcomes of crowdworkers, machine-learning [36], graph-theoretic [42], bootstrapping [79], probability [41], semantic differential [31], text mining [80] based approaches were shown. Special works [57,81] treated detection when individuals are cheating. In addition, other works showed the suitability of using the crowd for quality checks, e.g. [82].

3.5.2. Measuring group outcomes. Measurement-related CS publications also treated assessments of work outcomes and quality issues of groups (data mining based [83], merit-based voting [84], combining expert groups and the crowd [67], collective idea evaluation [28], evaluation methods comparing [85]).

3.5.3. Measurement-performance relationship. Though measurement-related CS literature generally implicitly assumes that quality assessments automatically lead to better work outcomes, CS publications concerning the relation between measurement and performance are very rare: The only work [62] concerning this relationship merely stated that bad quality in the initial step fosters the improvement of quality by the crowd. Due to the importance of a positive measurement-performance relationship as a pre-condition for reasonable CS performance measurement activities, I formulate:

P_4: Measurement of CS work results is positively associated with the individual and group-level outcomes in CS.

Before empirically investigating the proposition P_4, future work should first define proper CS outcomes metrics, cf. [19,86].

3.6. Leadership

[72] empirically investigated crowdsourcing from a psychological contract perspective by qualitative case studies involving IONA Technologies, Philips Medical Systems, and Telefonica and additionally by a large-scale survey. Results revealed a set of customer and community high-level obligations that are associated with crowdsourcing success (mainly the creation of a transparent, responsible, sustainable, and trustable working environment). It is remarkable that though all of these success factors are associated with the transformational leadership style in HR literature, transformational leadership style was not considered or discussed in [72]. To foster the acceptance of CS, [87] emphasized the key role of a so-called "proactive executive leadership" which is also quite similar to the known transformational leadership style. Since the transformational leadership style seems to be a pre-condition for successfully running CS, I formulate:

P_5: The transformational leadership style is positively associated with the individual and group-level outcomes in CS.

3.7. Compensation

Prior HRM research on compensation has mainly investigated the general role of intrinsic and extrinsic motives, as well as the role of monetary payments in particular [51,88]. The most frequently mentioned motives of users participating in crowdsourcing are: (1) money [12,25,31,44], (2) altruism [12,25,31], (3) fun [25,30,31], (4) reputation/attention [25,44], and (5) learning [25,44]. The empirical results regarding intrinsic or extrinsic factors more importantly differ: Following the empirical study of [30], earning money is by far the main reason for engaging in crowdsourcing. In contrast, [27] found that intrinsic motivation is more important than extrinsic motivation in inducing participation in crowdsourcing. Higher-order intrinsic factors such as fortune and fulfilment were revealed as predictors of high work quality whereas lower order intrinsic/extrinsic factors such as fun and fame were correlated with low quality of work [30]. Crowdworkers who find a task boring under-performed significantly [30]. The pay-satisfaction correlated with the pay level [30], confirming prior finding in HRM research. [45] found that both, extrinsic and intrinsic motivations affect crowdsourcing activity while intrinsic motivation seems to generate more substantial contributions.

3.7.1. Money and attention as extrinsic factors. Most work has focused on the role of money as a clear extrinsic factor: [89] analyzed the affection of monetary payments on work quality by a crowdsourcing experiment, and found no significant quality differences between paid and unpaid work. [57] showed

that using better crowdworkers saves a lot of costs, even if they are slightly more expensive than other workers. Other studies found that higher payment and rewards encouraged better work [23,24,30]. However, the existing studies on crowdsourcing motives and cognitive processes are mostly very rudimental and not grounded on motivation theories known from psychology research with a few exceptions (e.g. [24,90]).

Besides the role of money, attention was investigated as another important extrinsic factor: As [91] showed, crowdworkers need attention for their work. There is a strong correlation between attention and further contributions. In addition, the analysis of [26] revealed, that the past experience of being a solver is a good predictor of future success.

3.7.2. Altruism and fun as intrinsic factors. Factor-specific works are very rare: As [32] with "crowd-pushing" noted, activities outside the company by an engaged user base crowd can lead to significant volunteered contributions. [30] found that fun is a clear motive to participate in low-paid crowdwork.

The discussion about the motivations to work (especially on the role of extrinsic versus intrinsic factors) is well-known in HRM research (e.g. [51]) and it seems that this discussion is currently recurring in CS research. Summarizing the CS research described above, there is no indication that crowdsourcing motives significantly differ from general working motives. Thus, I formulate:

P_6: Users' crowdsourcing motives do not significantly differ from general working motives.

3.7.3. Designing incentive systems. Specific incentive systems CS research on fairness [10,29], optimal prize structures [5,9] and pricing behavior [15,47] exist. In addition, pragmatic best-practice approaches came from industry: E.g. MobileWorks sets the pay level automatically based on the estimated crowdworker effort [35]. This approach is in line with the results of [30] which recommends setting the pay level equal to the effort. Even simpler, mTurk recommends paying workers at USD 5-6 per hour. E.g. `InnoCentive` announces thousands of USD for complex and knowledge intensive R&D tasks. In contrast, for trivial digital-image tagging work, mTurk offers only a few cents [3]. But it is remarkable that the incentive intensity depends on the complexity and knowledge intensity of work [3]. MobileWorks workers e.g. in India earn an average above-market salary of roughly USD 1.5 per hour working on computers and USD 0.6 per hour working on mobile devices [35].

However, HRM research on the relationship between payment variation and organizational outcomes has also yielded inconsistent results [88]. In summary, the incentive-behavior/outcome relationships are not CS-specific, but rather similar to general mechanisms well-researched in HRM (e.g. [51,88]). Thus, I formulate:

P_7: Incentive-behavior/outcome relationships in CS do not significantly differ from general incentive mechanisms.

But, following the research directions of market wages in HRM research [51, pp. 203] in combination with individual as well as micro task differentiated payments [5,23,24,30,35,57], a higher variation of individual payments in CS arise. I formulate:

P_8: The variation of individual payments in CS is greater than the regular pay variation in industry.

3.8. Legal and ethical issues

There are only a few fragmented discussions of legal and ethical issues in CS, e.g. for crowdsourced health studies [92], behavioral research [18] and labor exploitation [93]. The sole conceptional comprehensive legal-related work [33] discusses employment law problems, patent inventorship and copyright ownership issues, and data security issues as the major legal problems. In addition, it is interesting that a higher pay level seems to be attracting more unethical workers [30]. Legal and ethical issues are not the main turf of the IS research in the proper sense. However, due to the business importance of *legal and ethical issues future analytical work* should deepen our understanding in these areas.

4. Framework guiding future research

As shown in figure 1, the framework guiding future crowdsourcing research spans both, (a) the coordination problem as the primary technological-/design-oriented challenge and (b) eight propositions from P_1 to P_8 to direct future empirical research:

4.1. Empirical investigation needs

The eight propositions (P_1 to P_8) directing future empirical research primarily focus on the effects of recruitment/selection fits, training/development investments, quality assessments, leadership styles, and incentives to individual/group performance outcomes. That is why before most of the propositions can be investigated, future work should first define proper performance outcomes metrics, cf. P_4 and [19,86].

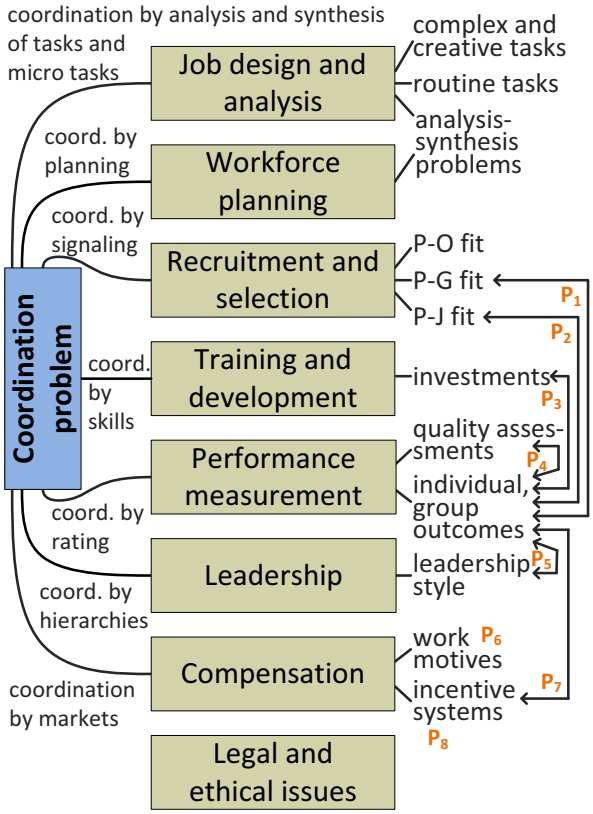

Figure 1: A framework guiding future crowdsourcing research from a HRM perspective.

4.2. Higher-order coordination mechanisms

As shown in figure 1, except the legal and ethical issues, every challenge from all other HRM areas is rooted in a coordination problem: E.g., job design and analysis primarily treated with task-coordination by the analysis and synthesis of tasks and micro tasks (cf. section 3.1.3). In every organization the main (and generally more complex) tasks have to be broken down into appropriate specific clear defined sub-tasks [micro tasks] (analysis-synthesis concept). The analysis-synthesis concept [63] comprises (a) the decomposition of the main task (goal) into sub-tasks delegable to people and (b) the synthesis of sub-tasks results in order to reach the goal of the whole organization. For example: The complex task of playing a music title has to be broken down into sub-tasks such as playing specific musical instruments by musicians (analysis part). The conductor is responsible for the orchestration of the musicians (synthesis part). Due to the application of the analysis-synthesis concept specific jobs requirements evolved which influence the job design for the various musicians and the conductor. A similar existing CS stems from [61] showing through a collaborative music-making example the concept of a (spectral) decomposition of the main task (here: a original recording) into several micro tasks which were offered to the crowd. The completed micro tasks (here: self-interpreted interpretations) were gathered and re-synthesized to the original corpus. The workforce planning is also part of a coordination problem (cf. section 3.2). The other HRM challenges are rooted in coordination by signaling, skills, rating, hierarchies, and markets. That is why fostering research on the coordination problem within CS is very promising:

E.g., picking up the idea of a layered model with expert subgroups from section 3.2 in conjunction with improved coordination mechanisms, the in section 3.1.3 described analysis-synthesis problem could be solved – by assigning the crowd to several analysis-synthesis duties as additional sub-tasks in their own right. Concerning recruitment and selection it is well-known from new institutional economics that signal-free markets running under uncertainty will fail (cf. market failure by Akerlof [94]). All markets including human factors run under uncertainty [95]. That is why, in order to solve the coordination problem when recruiting crowdworkers, CS have to implement higher-order coordination mechanisms based on signals and reputation systems (cf. signaling theory by Spence [95]). As stated in section 3.3.3, future work should extend the functionality of mechanisms for matching and coordination between the potential crowdworker (applicant) and the offered micro task. From organization literature (e.g. [96]) it is well known that the negotiation is an important and appropriate mechanism for both the organization and the applicant when recruiting and contracting. Taking a look at the automated negotiation literature (e.g. [97]) several approaches can be distinguished. Despite the clear conceptional and empirical successes of auctions as the simplest negotiation entries, there are more promising approaches including argumentation-based models, smarter markets, and much more complex negotiation approaches using intelligent negotiating software agents towards programming the global brain realizing collective intelligence. But, since all existing crowdsourcing recruiting mechanisms are still based on simple matching algorithms or auctions (e.g. [11]), future work should foster the development of more complex negotiation-/argumentation-based approaches.

Last but not least, leadership and compensation challenges are rooted in coordination problems as well (cf. coordination by hierarchies and by markets [52,64]).

5. Conclusion, Limitations, Future Work

Following the research call of [46] I reviewed all the existing "substantial" scientific crowdsourcing work included in top peer-reviewed journals and conferences related to the HRM perspective and built up a comprehensive literature review. Based on this review I adapted the framework of [1] to guide future research and identified the coordination problem as the primary technological-/design-oriented research challenge and additionally propose eight propositions to direct future empirical research.

Because of the restriction of the analysis to peer-reviewed publications with completed research work, a few publications containing interesting material were potentially excluded from this review. This excluded material could contain negative or non-confirmatory (test) results, potentially resulting in publication bias. Since I analyzed the existing crowdsourcing literature from a HRM perspective of the core HRM areas based on the research agenda of [1] and the (e-)leadership extension, it has to be acknowledged that further HRM functions/areas exist (e.g. HR controlling and data analysis [86]).

Future work on guiding CS research should relax the limitations of this review via extending the HRM perspective in the following areas: employment termination, HR controlling and data analysis [86], as well as HR marketing and employer branding. In addition – as described in section 3.1.3 – following [64] a strong interdisciplinary study of the underlying coordination problem in crowdsourcing activities is recommended.

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