Human Factors and Procurement: Lessons Learnt from a High-Value Procurement Exercise

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SUMMARY

Human Factors can inform and enhance traditional procurement processes by capturing the users' input and considering the wider system into which the products will be implemented. Despite this, traditional procurement processes do not typically consider integrating HFE into the process in a systematic way. This paper describes the role of Human Factors in the different phases of a large procurement project and the lessons learnt for the procurement of hospital beds within one large NHS Hospital Trust. The aim of the procurement project was to determine the best solution that includes a variety of products and service contract from one supplier. A total of six different bedframes and two different types of mattress needed to be considered. The role of the HFE team was to provide advice at strategic project meetings, support the specification design, conduct an HFE evaluation of the products and ensuring a system's perspective was considered throughout the process. Across all the product types, the HFE evaluation included 27 simulation testing sessions followed by feedback from staff on in-situ use on 23 different wards. Key lessons learnt included the value of qualitative data can add to support the decision-making process in procurement projects, the need to understand clinical needs as in this context there is no one perfect product due to the wide range of applications, and the need for HFE specialists to have a better understanding of the procurement process and their involvement across all phases of this type of project.

KEYWORDS

Healthcare, Procurement, Systems Approach

Introduction

As a design science and with users and people at its centre, Human Factors and Ergonomics (HFE) is well placed to support the procurement process. Despite this though, traditional procurement processes do not typically consider integrating HFE into the process in a systematic way, and rather just add it as an afterthought or supplement (Cassano-Piché et al., 2010). Extensive work has been done describing the evaluation of medical products with regards to the general usability at a more micro-ergonomic level, for example the anthropometric and biomechanical aspects (e.g. Adeodu et al., 2014; Kim et al., 2009; Mehta et al., 2011). However, as these products are brought into existing work systems, there is also a need to assess the usability relative to the work system they will be integrated into, which may impact the decisions made during the procurement process.

Human factors-informed procurement enhances the traditional procurement process by including a multidisciplinary team, frontline staff or user participation and HFE expertise to lead on the HFE methods (Cassano-Piché et al., 2010). One key contribution of HFE to the procurement process is the information on usability it can provide, namely the functionality, interface design, and training and learning requirements (Carayon, 2011). In addition to this, HFE can provide the tools to consider the product relative to the users, tasks and environments, which is essential (Wilson & Sharples, 2015). However, to be successfully integrated into the procurement process, one needs to

understand the complexities, limitations and structure the process may impose due to legal requirements, as highlighted by Hignett and Lang (2013). The tender process, which may be part of the procurement process, may have the following phases: advertisement, registration of interest, notification of tender specifications, product evaluations, awarding and implementation of the contract. To reap all the benefits HFE can offer procurement projects and to ensure HFE can be appropriately applied, this will require HFE to be integrated early on and throughout the process and not just in the evaluation stage. This paper describes the role of HFE in the procurement process and the lessons learnt for the procurement of hospital beds within one large NHS Hospital Trust.

Method

This procurement project aimed to select a supplier that would provide beds, mattresses, and a service contract for these products at a large NHS Hospital trust that offers a wide range of general services. To support this project and the decision-making process, a diverse project team (i.e. Finance, Procurement, Medical Engineering and Physics, Human Factors, Infection control, Estates, Tissue Viability) that was representative of the key services for maintaining and supplying beds for the service was assembled. The team was responsible for evaluating the service package and different models in the product categories to determine the most suitable ones for a range of different bed types and mattresses for the Hospital Trust. A total of six different bed types (i.e. medical and surgical beds, critical care beds, birthing beds, bariatric beds, paediatric beds and cots, low bedframes) and two different types of mattress (i.e. dynamic surface, foam surface) needed to be considered. The components of the different phases in this procurement project and the role of the HFE team has been depicted in Figure 1.

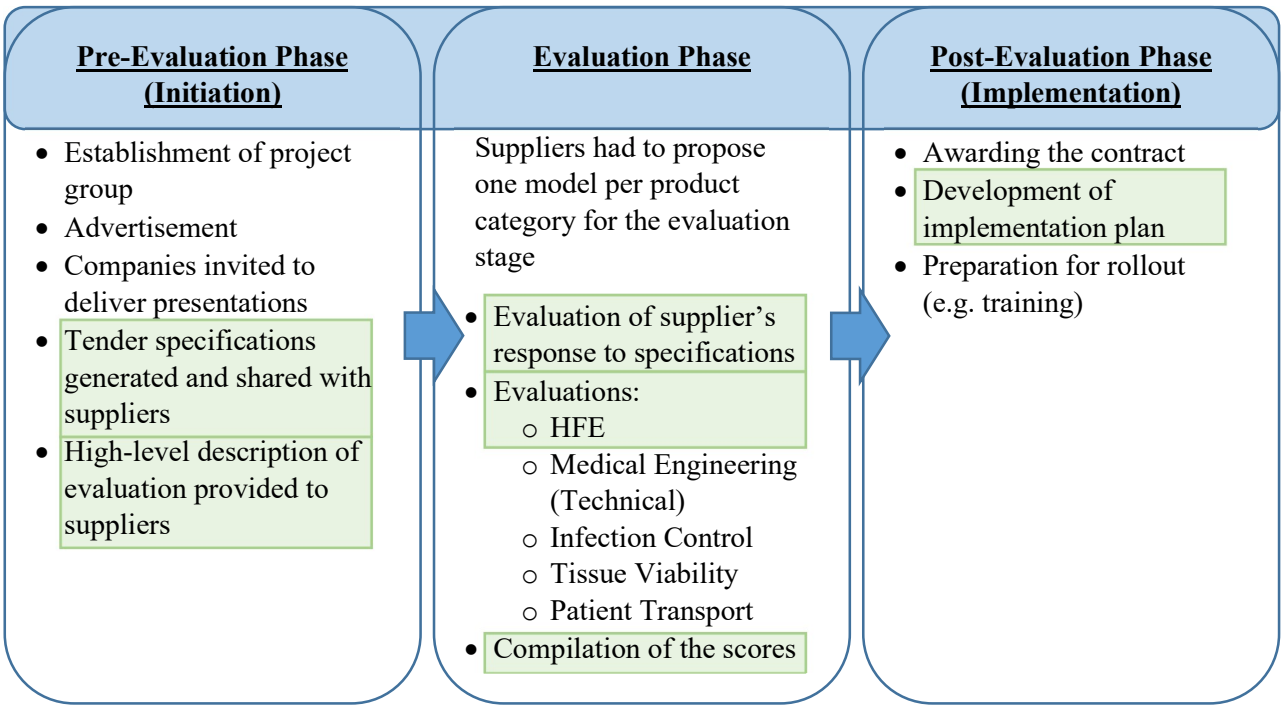

Figure 1: The components of the different phases in this procurement project and the role and involvement of the HFE team (marked in green).

The HFE evaluations focused on the functionality, interface design elements and capturing the user perspective on these products, with particular focus on the work system wherein these products would be used, rather than the micro-ergonomic aspects. The HFE evaluation consisted of two

phases at two different time points, simulation testing in a simulation centre followed by feedback from staff on in-situ use (ward testing). These protocols were based on the seven principles of universal design (Story, 1998) and usability heuristics (Nielsen, 1994). Data for both phases was captured using a structured questionnaire that consisted of both open-ended and Likert Scale questions.

The simulation session provided an opportunity to conduct usability walkthroughs and usability tests. Participants were recruited from across the clinical workforce for the products that may be selected for their work area. Frontline staff were provided with an opportunity during the simulation to interact with the products as well as test several clinical scenarios (i.e. CPR, patient transfer and hoist tasks) and then debriefed as a group to collect the group's feedback on the products. Staff were also asked to complete a questionnaire on the products following the simulation session, which included questions on the structural and functional features of the product, comparison to the products currently in use, movement considerations, control panel and display use, evaluation of clinical scenarios as well as the general impression and patient considerations. The open questions asked staff to consider the products compatibility with other pieces of equipment (e.g. oxygen, IV stands), essential features for the patient group, staff requirements for use of the product, training requirements and provided an opportunity for any additional comments. The simulation testing also used group consensus to determine how the product compared to the current model in use, the top three features, worst three features and if any "dealbreakers" were present. The ward questionnaire included questions on complexity regarding the use of the product, function integration, and comparison to the other products currently in use. The open questions asked staff to consider the products compatibility with other pieces of equipment, problems encountered during use, entrapment concerns, top three features, worst three features and if any "dealbreakers" were identified. The questionnaire used for the ward testing also included an adapted System Usability Scale (Brooke, 1996). In both the simulation and ward questionnaires, each Likert-based question was normalized by determining the average score per question across the testing session for all participants (not including the System Usability Scale). Both the ward and simulation testing were weighted equally and percentages were determined for each product for each phase.

The HFE qualitative and quantitative results were fed-back to the project group to support the discussion of the results from evaluations conducted by the other teams (e.g. medical engineering) and support the decision-making process. As the project group required predominantly quantitative results, the qualitative HFE results from both simulation and ward phases were assessed by a panel that included HFE specialists and clinical educators. Each product was given a grade label by the panel based on the summary of key qualitative results from the group discussion in the simulation testing and the open-ended questions from the questionnaires used in both testing phases. The grading scale was defined by the project team and used by the other evaluation teams in earlier phases of the project. The lowest grade (Grade 0) was deemed unacceptable and defined as the product completely failing to meet the required standard or does not provide an answer. The highest grade (Grade 4) was deemed excellent and defined as the product meeting the required standard in all material respects and exceeds some or all the major requirements. Any products that scored a Grade 1 (weak) or 0 (unacceptable) were highlighted to the project team, with specific justification for these grades. The final summary reports submitted to the project group included not only the quantitative scores from the questionnaires but key qualitative results that staff felt were "dealbreakers" as well as highlighting any results that were contradictory to the specifications provided to the suppliers in the pre-evaluation phase. The HFE team were also involved in the discussion of the results, to highlight or draw out any essential results from the HFE evaluation needed for the discussion and to support the development of potential resolutions. Similarly, the results from the other evaluations (e.g. technical, tissue viability) were brought back to the project group and discussed.

Findings: HFE Involvement, Challenges and Lessons Learnt

The aim of this paper was to describe the role of HFE in this type of procurement project, the challenges faced, and the lessons learnt. Several unique characteristics of this type of project naturally resulted in constraints for the project team and the evaluations and as a result created challenges. These characteristics included the time span of these types of projects and the prescribed process by NHS procurement. This project has spanned several years, with some preliminary assessments occurring in 2019 and then the process was restarted in 2020. The simulation testing occurred between September and October 2020 with 27 testing sessions being conducted, one per product model. The participant groups ranged from two to eight participants per session who were clinical staff that would be using these products if the contract was awarded to that supplier. The ward testing was conducted between March and April 2021, and 21 products were placed onto 23 wards for approximately two weeks. Not all products had a patient use them in this time. Staff were asked to complete a questionnaire during this time period and a range of one to 22 questionnaires were returned per ward. An additional risk validation study of certain products was conducted by the HFE team in October 2021 and September to November 2022. Despite this length of time, the project team was very lucky in that all of the core members remained constant and a continuity could be provided throughout the evaluation phase. Another key characteristic of this project was that although the HFE team was called in relatively early in the project timeline, the tender process was already prescribed by NHS procurement. This created some specific requirements for the testing. Due to the prescribed process, the specifications were required early in the process (Figure 1, pre-evaluation phase) and could not be informed by the simulation testing. This highlighted that at the start of the process, the level of detail required in the specifications was not fully known. Another key influence on this project was that of the COVID-19 pandemic. Although this had a negative effect on recruiting participants for the simulation testing, it had a positive effect on the team resources required for the simulation testing. As a result of the pandemic, the simulation centre did not have its usual courses which allowed for space and staff to be available to conduct the simulation testing.

Additional challenges included the resource intensive nature of this project, low overall number of volunteers and low numbers in certain staff groups, the assumption that the “best” products would be put forward by the suppliers, and managing the expectations of staff who participated in the testing phases. This project was resource intensive on multiple levels including the high volume of testing required with limited resources, the team requirements on simulation testing days for the HFE evaluation, and the data analysis which included qualitative analysis. An underlying assumption in this project was that the “best” products on the market would be put forward by the suppliers, however when it came to product testing, frontline staff identified elements that due to various reasons made the product not suitable or the best option for that patient group. This highlights how trade-offs are made and how these products often need to serve a varied patient group and therefore will not be the “best” solution for all. As this project required the team to select a supplier that offered the best combined offer, the expectations of staff involved in the testing phases had to be managed as their preferred product may not have been selected. Furthermore the simulation testing highlighted some of the limitations of the specification design and the lack of range of products for certain categories. These included that the specifications were too vague in certain areas.

Key lessons learnt included the positive effect and benefit of having a multidisciplinary team that supported the HFE evaluations, the value of qualitative data in these types of projects and the need for HFE specialists to have a better understanding of the procurement process. The multidisciplinary HFE team that conducted the HFE evaluations included HFE specialists, technical leads, and multi-professional clinical educators that had a range of clinical backgrounds. This not

only allowed the testing to run in a smooth and efficient manner due to the team size and specialty range but also assisted in troubleshooting problems that arose on testing days. The value of the qualitative data was highlighted during the discussion of the products, not only in project team meetings but throughout the process as queries on the products arose. The qualitative data provided tangible examples of usability concerns and context for the quantitative results. Another key lesson learnt was that a better understanding is needed of the requirements and constraints at a project initiation level of the procurement process to design better evaluations and scoring systems. Despite numerous aspects of this project prescribed by NHS Procurement, there was still a degree of evolution in this project. With a better understanding of the inherent constraints and natural evolution of these types of projects by the broader project and evaluation team including the HFE specialists, better interventions that work within these limits could be designed, unsuitable products may be excluded and the limited resources can be utilized to evaluate the key contender products better. This is particularly important as testing needs to be fair and equal but also recognize the resources that may be required, especially in healthcare, may not be available. Additional key lessons learnt included that there are numerous opportunities to potentially enhance design and work with the manufacturers to ensure a "good fit", the need to understand clinical needs as in this context there is no one perfect product due to the wide range of applications required of the products, and the potential role of HFE in the different procurement phases (e.g. initiation, evaluation, implementation). Furthermore, clarity of the HFE role is essential at all stages – HFE Specialists provide an objective, evidence-based approach to support the organisation to make informed decisions about "best fit package" and not just individual product assessments.

Although the focus of this paper was not the results from the HFE evaluation, several of the design and usability concerns were identified that highlighted key lessons learnt. Some of the key design concerns raised through the HFE assessment across the products included complicated staff interface buttons, the design of the head-end in certain models restricted the access to the patient's head, and the visibility and ease of use of the CPR mechanism. Design features identified by staff as limitations that were as a result of trade-offs included "how low was low enough" for beds and the use of adult beds for specialty patient groups (e.g. paediatric patients). Beds that were able to go as low as possible often had other limitations due to the structural requirements needed to allow the lowering of the bed. Several examples were identified whereby specialty patient groups required an alternative product (e.g. paediatric patients requiring general adult medical beds) whereby then certain structural elements were not designed for this population group (e.g. cot sides). These two examples highlighted the compromise the project team needed to find as the patient group to use the product was so broad. This required extensive discussions on the results, additional risk evaluations and additional discussions with frontline staff to determine which elements were critical.

Discussion

A key challenge and aim of the procurement process is to find a balance between the hospital's requirements from the product which may include being used for a range of patient groups, and the terms of the service contract at the best possible financial price (Hignett & Lang, 2013; Western Canada Human Factors Collaborative, 2017). The HFE evaluation in this procurement project aimed to capture elements of usability, frontline's staff perspective of the products and utility with regards to how well these products would fit into the existing work systems. Accordingly, the HFE indicators selected were related to general usability but also wider work system considerations, for example patient consideration, other tool and technology interactions, and different tasks associated with these products.

As highlighted in the document "Guidance for Human Factors Evaluations in the Procurement of Medical Devices, Equipment and Technology" produced by the Western Canada Human Factors Collaborative (2017), four recommended evaluation methods have been proposed for HFE

evaluations in procurement activities. These consist of usability walkthroughs, heuristic evaluations, usability testing and field studies. This procurement project utilized three of these four methods namely usability walkthroughs, usability testing and field studies. The benefit of using these three different recommended evaluation methods is that a range of sensitivities, objectivity, control and realism was covered (low, medium and high). Furthermore, the usability walkthrough and usability testing both used task scenarios, which allowed several key design concerns to be identified (e.g. limitations associated with CPR mechanisms). In an earlier phase of this procurement project (April 2019), a heuristic evaluation was included but once the project was restarted in 2020 this was removed for the evaluation design. This was excluded due to the volume of products that needed to be tested in the revised project in 2020 (27 models tested) and the available resources. Furthermore, it was decided to prioritise end-user involvement and the selected methods have better control for unknown variables and improved objectivity (Western Canada Human Factors Collaborative, 2017).

Some of the limitations of this project included that a heuristic evaluation of the products could not be performed, and the limited sample sizes for certain testing sessions for both the ward and simulation testing sessions. Some of the limitations that resulted and challenges experienced by the HFE team were as a result of the procurement process and potentially the limited involvement in the initiation phase. This point has also been highlighted by Hignett and Lang (2013), specifically the limitations associated with the specifications such as insufficient detail and ambiguous results on these in the returned documentation from the suppliers. Greater HFE involvement upfront, particularly in the initiation phase, could assist with the development of more precise specifications, especially defining more specific HFE requirements more clearly.

Key strengths of this project included incorporating a system's perspective throughout this project, the commitment by the organisation to have HFE included in this project, increasing the involvement of end-users and due to consistent results from multiple rounds of testing for certain product groups, the method and tools proved reliable. A system's perspective was brought into this piece of work not only through the HFE evaluations, but by including the HFE team in the project team and in the discussion of all the evaluation results. This also ensured that there was a representative to feedback the opinion of end-users on those products at multiple stages. Furthermore, the strong support from the project manager and the collaborative nature across the different evaluation team members allowed for the resolution of operational issues, allowed for through evaluations to take place and also ensured that the HFE team was supported in feeding back frontline staff's concerns. The co-location of certain stages of the evaluation allowed for issues identified to be checked by the other evaluation teams in an efficient manner.

Conclusion

This paper describes the role of HFE in the procurement process and the lessons learnt for the procurement of hospital beds within one large NHS Hospital Trust. The aim of this procurement project was not to find the best products on the market for certain product types, but rather determine the best solution that includes products and service contract from one supplier that best meets the needs for one Hospital Trust. A key element and contribution of the HFE team to this procurement project was providing the perspective of how these products may or may not fit into the existing work system and therefore had a macro-ergonomic approach. The HFE team was involved to different degrees in the initiation, evaluation and post-evaluation phases and played an active role in the project team. In addition to designing and conducting the HFE evaluation component of the evaluation phase, the team provided strategic advice at project meetings across all three phases, ensuring that a system's perspective and the perspective of frontline staff was considered. This highlights some of the benefits and support HFE can provide the procurement process, namely a system's approach, the user's perspective and objective and varied tools and

approaches. Challenges emerged as a result of the procurement process and included the specific requirements and constraints placed on testing due legal requirements, the assumption that the "best" products would be put forward by the suppliers, and managing the expectations of staff who participated in the testing phases. Key lessons learnt included the value of qualitative data can add to the discussion and support the decision-making process, that there are numerous opportunities to potentially enhance design and work with the manufacturers to ensure a "good fit", the need to understand clinical needs as in this context there is no one perfect product due to the wide range of applications, the need for HFE specialists to have a better understanding of the procurement process and their involvement across all phases of this type of project. With a better understanding of the inherent constraints of these types of projects by HFE specialists, better evaluation designs that work within these limits could be created and the limited resources, particularly in healthcare, can be utilized more effectively. As this project is still ongoing and currently in the post-evaluation phase (implementation), there is still a role for HFE as now changes to the work system start to emerge as these products become integrated into numerous subsystems within the existing work system (e.g. device library, complaints system).

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