

THE ROLE OF DATA IN THE DAILY WORK OF CANADIAN ERGONOMISTS – AN INTERVIEW STUDY

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This paper presents results from 22 semi-structured interviews with professional ergonomists across Canada discussing the use of data in their daily work. Most ergonomists report initiating study of a job using observation, interviews, task analysis, and photography/video. Many then proceed to quantitative analysis of risk factors in order to provide sufficient motivation to push for a desired intervention, operating in a 'problem convincer' mode. Some ergonomists report that, when working in a high trust environment where there is acknowledgement of a problem, they are able to use their qualitative evaluation to move on directly to design alternatives – a solution building mode. Ergonomists in larger companies appear to have begun implementing 'score card' type tools that anchor both leading and lagging ergonomics indicators into their companies' development processes. Such approaches appear to help engage senior management in ensuring action on the ergonomics agenda.

Keywords: Professional practice, human factors, organisational design and management

LE RÔLE DES DONNÉES DANS LE TRAVAIL QUOTIDIEN DES ERGONOMES CANADIENS – UNE ENQUÊTE PAR ENTREVUE

Cette communication présente les résultats de 22 entrevues semi-structurées menées auprès d'ergonomes dans différentes régions du Canada et aborde l'utilisation des données dans leur travail quotidien. La plupart des ergonomes ont indiqué qu'ils commencent l'étude d'un emploi en faisant appel aux observations, entrevues, analyses des tâches et photos et vidéo. Ensuite, bon nombre d'entre eux utilisent une analyse quantitative des facteurs de risque afin de recueillir suffisamment d'éléments motivateurs pour entreprendre une intervention souhaitée, ce qui les met en mode de « conviction de problème ». Certains ergonomes signalent que lorsqu'ils travaillent dans un milieu où le degré de confiance est élevé, par rapport à la reconnaissance d'un problème, ils peuvent utiliser leur évaluation qualitative pour parvenir directement aux alternatives de conception, soit le mode « construction de solution ». Les ergonomes oeuvrant dans les grandes entreprises semblent avoir mis en application des outils de « carte de pointage » qui établissent les indicateurs ergonomiques avancés et glissants dans les processus de développement de l'entreprise. De telles démarches semblent favoriser la participation de la haute direction dans les mesures liées à l'ergonomie et devant être entreprises.

Mots clés : pratique professionnelle, ergonomie, conception et gestion organisationnelles

INTRODUCTION

This paper presents the results of an interview study examining the daily practice of Canadian ergonomists. This is part of a larger study that includes interviews with Swedish ergonomists (Laring et al., 2007) as well as industrial engineers concerning the tools and routines regularly used by these two professions. The background to this research is the 'gap' that has been suggested to exist between the work of ergonomists and the work of industrial engineers in the design and development of workplaces resulting in consequences for both system performance and operator wellbeing (Perrow, 1983). The purpose of these interviews is to understand the current practice of these two groups and identify opportunities for improving the integration of ergonomics considerations as a routine element of workplace development processes. This paper reports on the practices reported by Canadian Ergonomists with respect to the use of data in their work. In this work the term data is used broadly and includes both quantitative and qualitative information related to both workstation-level risk factors and the ergonomics and business process aspects of relevance to the practitioner.

METHODS

This paper presents preliminary analyses from a set of 22 interviews with Canadian professional ergonomists about the tools and approaches used in their daily work. Semi-structured interviews, of about 1-hour in length, were audio tape recorded, transcribed and entered into a qualitative data management software tool (QSR: NVIVO). A preliminary coding scheme was devised and then revised on the basis of reading of the transcripts. Sections of interviews based on the codes were extracted and then examined to develop the analysis. Participants came from five Canadian Provinces and Territories, with an average age of 40.8 and working experience of 14.9 years. Slightly more than half the participants were men (55% male, 45% female). The majority had a Masters degree or higher (77%); just over half work as employees (55%) while the remainder work in consulting (45%); a quarter of participants were affiliated with an academic institution (27%).

RESULTS

Observations and Task Analysis

Observations and task analysis (TA) was often seen as the first step for the ergonomist: *"it's the first step for understanding the job. So, in order for me to identify risks, whether I'm doing a claims WCB thing or whether I'm doing a job re-design, it's a tool to understand the job and then to break it down and identify the different components of a job, the different tasks, different risk factors and concerns on the job."* Ergonomists also reported TA as a means to understand system performance issues *"You can also see potential bottlenecks, and so you can see instances of where people are waiting to perform another task and you can also see where there are some really good designs within a space"*. System performance was also addressed by shifting observational focus from the worker perspective to the product: *"For the second step, I'll use the example of a [product] that has been dropped off. The staff members talk to me and tell me what they are doing with that [product] for each of the different processes to see how this is done how the physical relationship works within that area"*. Another point made about observation is that it should be done with care: *"If you see someone observing you, you are going to try to do the job the best that you can, which is different from how you normally do it. Also, people may perceive you as being in the way or being nosy."*

Interviews & Focus Groups

Ergonomists frequently combined their observation with operator interviews to gain insights into the process as to where and when to make further observations: *"The interviews are very useful when we do the observations because if the person...say(s) 'oh on Monday it's really awful', then we go on the Monday and see what's happening and try to understand what is the cause of the problem."*

Conducting short interviews before beginning observation was reported helpful as it prevented the ergonomist's observations and preliminary conceptions from distorting their discussion with workers in a post-observation interview: *"First, I interviewed them - before seeing them work. If I see the job first, I won't ask the same questions.... So, there are no preconceived ideas beforehand. I speak to them for about 5-10 minutes."* Ergonomists also describe these interviews as a kind of staged discussion, narrowing in on the particular areas of concern such as musculoskeletal disorders. One ergonomist, involved in design processes, uses group interviews, or focus groups, to engage operators in the design process: *"During our design stages, we have full focus groups generally at two-week intervals throughout the design process."* In some cases the interview is seen as essential: *"I'd say I need to do interviews... I need that. If it's impossible to have interviews with workers I won't go."*

Imaging

Ergonomists almost always used photos and videos in their work. Comments on this point included the following: *"Images I will use wherever I can, if I need to demonstrate how something is done."*; and *"There are not too many things I think about without having a picture"*. These are used to help communicate about a job as well as to make training efforts more immediate to the audience: *"If I was showing a car plant or something, it just wouldn't be the same. It needs to be them in their work environment, doing the jobs that they do and then talking about that. So, I use them all the time."* In addition, still photos are seen as a means of providing follow-up documentation: *"One of the great things with a camera, is that you can take a pre-picture and a post-picture of the same area and you can actually see the differences."*

Video recordings were broadly used, both to help capture the right instant of time for stop-frame posture analysis, as well as to permit assessment of repetitions and exposure times once the ergonomist had returned to the office: *"I do a lot of time-and-motion analysis, and I just find that it's a really useful tool time-wise to be able to go to a site, videotape, and then come back and look."* Ergonomists also report using still photos and video to assist with their analysis once they return to their office, where frames can be carefully selected and analysed in detail.

Quantification of Risk

Two distinct approaches emerged regarding the need for quantification of risk. One approach encompasses situations in which quantified data is used to convince or motivate decision makers to make changes: *"Pictures would help clarify what direction we want to go.... But yes, the number is what is going to push it more"* and *"we use tools when we need to convince"*. These practitioners saw quantified information as means of communicating with engineers: *"...If you go back to the engineer... and if we just give them words, it doesn't work. If we give them numbers, graphics, then 'ahhh' they understand"*.

Risk factor quantification was also reportedly used to check compliance to a standard to see if a job is *"acceptable or not acceptable"* or *"in compliance with Ministry of Labour guidelines"*.

Some ergonomists, however, are using numbers to shift emphasis away from a charged pass/fail debate and emphasise priority setting instead. In this way measurement is used to diffuse a tense situation: *"the score is definitely helpful, I think at the end of the day, everyone wants a score. What we are trying to push a little bit more now, is trying to get away from the safe - unsafe and get more into differentiating tasks based on risks... So, instead of... -- it's okay or it's not okay -- we say, these are the ones we need to look at first and these of the ones that can wait a little bit. We're definitely trying to use that approach a little bit more, it seems let everybody relax a little bit."* One challenge reported is the selection of which variables to quantify for any given situation: *"The most difficult thing in my job is to choose the variable to use. Every time the variables are different: there's not one way. For 20 years I've been a consultant and my office is like a... paper everywhere - there's not a project where I can take it, change the numbers and leave it at that."*

A second approach reported by ergonomists suggests that quantification of risk factors is not always necessary: *"when companies call us and they say 'Can you help us improve that workstation?', they know there's a risk. They don't have to be convinced - by tools, by equipment - they know there's a risk."* Instead of quantification the ergonomist's time could be better spent on solution building: *"if we use those tools, it's going to take more time. Is it relevant? Do they need to spend those, maybe, 10 hours and that amount of money on that specific [thing]? Or should we take 10 hours to find different types of equipment that would be better suited?"* and similarly, *"Why spend money. You see. It's what everybody knows."* Ergonomists working at this level seem to have an easier time of implementation: *"it's just a question of, 'how do we reduce the reach distances here'... Or, 'what's the real problem?' And I'll say, 'Look, the problem is the reach distance'. And they'll say, 'Oh you know what? We've had a couple of suggestions already on how to reduce that and now you're telling use that it's important?' -Yup, it's important' - 'Ok, we'll fix it'. Boom - done."*

The ability to skip the time and expense of quantification seems to depend in part on the credibility of the ergonomists: *"in some organizations you need to come with the numbers because nobody believes you."* Another participant expressed it this way: *"I'd like to think that our group is hired for expertise and opinion, but at the same time, in probably, I would say, all business, if you don't have a number you don't have much for some of them."* In the absence of a trust relationship and an improvement focus, ergonomists use numbers to position themselves as *"... third party objective opinion"* who *"...measure everything... so that it's more validated, it's more reproducible, its more solid data to based decisions on"*. A progressive approach, in which the ergonomist adds detailed quantification only as required in the project, is also described: *"Okay , you don't think it's important? I will go a bit further, then I will go with my dynamometer and I will measure exactly what the push is even if I could see she was really pushing. Then I will measure it and say, 'Okay you think it's not, but it's 50 lbs' and then okay you don't think it's not so often but I'm going to measure it..."*

One exception to this might be the use of human models that can integrate disparate observations to provide insight not available from qualitative analysis that are helpful for more complex situations.

Quantification in Recommendations

Another aspect of quantification discussed by ergonomists included the use quantified specifications when presenting proposed design changes: *"It's also how people communicate, especially engineers, they want to know inches and centimetres, they don't want elbow heights and things like this"*. Here again quantification is seen to help ergonomists communicate with engineers. *"In this report I included activities and times... lots*

of numbers because if you go back to the engineer - in 90% of my projects there's an engineer somewhere - and if we give them just words, it doesn't work. If we give them numbers, graphics, then 'ahhh', they understand." Here again we see an alternative view where quantification in reports is less important: *"Generally I find that, I do include numbers, but in the discussion on the report, people don't tend to dwell on the numbers too much".*

While many ergonomists mention including cost of changes in their reporting, there were also comments acknowledging the difficulty of getting detailed cost of injury data from companies, particularly for the less well documented indirect costs of injury: *"So we're struggling with that a bit because there's no standard way in industry or anything, there's no standard way to do cost-benefit. How do we capture that in a way that helps the plants do that?"*

Process Tools

A few ergonomists, generally working with larger companies, report initiating the use of 'score cards' and 'audit tools' that help anchor ergonomics considerations into corporate reporting in order to *"put ergonomics right up there with all the major metrics that are being measured.... we have a separate score dot for ergonomics now that is visible, not just embedded into the health and safety [score], as before"*. Such scores can then be used as a means to help motivate designers to include ergonomics in design projects: *"I mean they could not do it, but then...they would receive a lower score in the engineering design section of the metrics that get reported upwards"* with possible reaction from more senior management. Such tools are also being used to set improvement targets at the organisational level *"... it was always put in at 50% (improvement), so we're really throwing the yardstick out there. You've got to aim for something out there, 'So what are you (the business area) going to do?'"*. These tools help activate more senior managers in the prevention effort: *"typically a [poor] score is not looked upon well from the president, and usually, a lot of the times the plant manager is being asked about it, and they don't like being asked about it."*

DISCUSSION

While there appears to be a range of approaches used by practitioners, there is also a wide range of relationships between ergonomists and the workplace, including short-term consultant, consultant with long-term relationship, in-house ergonomists, and corporate ergonomists serving multiple sites. This has prompted us to shift discussion from strict definitions of 'internal' or 'external' (Laring et al., 2007) to more nuanced concept of the ergonomists-workplace relationship based on trust, credibility, and communication networks that affect the ergonomists ability to influence workplace change (Theberge et al., 2008).

Depending upon the relationship that the ergonomist has with the workplace parties, there seems to be two main routes by which data is used by ergonomists. In all cases ergonomists begin their analysis work with qualitative methods including observation, interviews, imaging, and task analysis. For ergonomists in a position of credibility and trust, or in an improvement oriented process, this initial analysis is often sufficient to generate improvement suggestions for the company (often reported using explicit numerical information like dimensions). If the company decision maker is sceptical or resistant to making improvements, or perhaps the ergonomists do not have a trust-based relationship with the company, then they proceed from qualitative assessment to conduct quantified analysis of the issues observed in order to convince decision makers of a problem and motivate action. In general, the qualitative analysis phase seems sufficient to help in solution building for many circumstances. Instead of using measurement for diagnosis, quantification tends more to support the communication

of professional judgment, support pass/fail analyses for legal responsibilities, and helps provide credibility for professional judgment.

Quantification can be used to manage conflict in circumstances when there is disagreement on the need to modify a job. While a range of quantitative tools are in use by ergonomists one of the reported challenges remains in deciding which indicators (and hence tools) should be used under what circumstances. Images remain an important complement to the quantified risk analysis data in communicating and convincing decision makers regarding job hazards. The emergence of process score cards with ergonomics elements may provide additional motivation for change while reducing the need for expensive quantification analysis. This may improve the cost benefit ratio of the companies' ergonomics program.

CONCLUSIONS

This paper has presented results surrounding the use of data by ergonomists. Future work will include a comparison of these results to those from interviews conducted with Swedish ergonomists that were presented to ACE in 2007 (Laring et al. 2007) and an extension of the experiences of ergonomists with different specific tools. In addition the project has recently initiated a second set of interviews to be conducted with professional industrial engineers regarding their use of human factors knowledge in their daily work routines (see in this conference: Mekitiak et al., 2008).

This analysis has identified two major modes of ergonomics practice – a solution building mode in which assessment is conducted only to that extent it helps with the development of new workplace solutions – and a problem convincer mode in which measurement and quantification is used to provide evidence to convince decision makers of the need for action. Large companies appear to be developing management performance metrics on ergonomics that may serve to embed ergonomics into companies' regular development work. This may serve to reduce the need for generating quantification proof of the need for each improvement and thereby reduce the overall cost of the ergonomics program.

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“HF in the Practice of Work System Design”

Examining the ‘Engineering-Ergo’ gap from the perspective of each profession:

- Understand current practices w.r.t. HF
- Identify opportunities to improve integration

Interview Phases:

1. Swedish ergonomists (Laring et al, 2007)
2. **Canadian ergonomist**
3. Canadian industrial engineers
(underway, see Mekitiak et. al ACE2008)

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Methods: Semi-Structured Interviews

- 22 Canadian ergonomists, 1-hour interviews
- Age: 40.8 yrs (avg)
- Experience: 14.9 yrs (avg)
- Gender: 55% male, 45% female
- Education: 77% Masters +
- Region: AB, BC, NWT, ON, PQ
- Work status: 55% employee, 45% consultant

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Results: 3 Tool Types in Use

1. Qualitative methods
 - Understand, gain insight, communicate
2. Quantitative methods
 - Convince, prioritize, assess, communicate
3. Process tools
 - Measure, motivate, set targets

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Results: Qualitative Methods

Most ergos begin with some kind of qualitative analysis:

1. Observation and task analysis
2. Interviews and focus groups
3. Images

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Results: Qualitative Methods

Qual. Data may suffice for improvements

“when companies call us and they say ‘Can you help us improve that workstation?’, they know there’s a risk. They don’t have to be convinced – by tools, by equipment – they know there’s a risk.”

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Results: Qualitative Methods

Is it an issue of *trust*?

“...in some organizations, you need to come up with the numbers because nobody believes you.”

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Results: Quantitative Methods

Includes:

- Checklists, Software tools, gauges

Used to:

1. Convince,
2. Prioritize,
3. Assess,
4. Communicate

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Quantitative Methods to *CONVINCE*

Function: to *convince*

“Pictures would help clarify what direction we want to go...But yes, the number is what’s going to push it more.”

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Quantitative Methods to *PRIORITIZE*

Function: to *prioritize* / *neutralize*

“So, instead of ... – it’s okay or it’s not okay – we say, these are the ones we need to look at first and these others can wait a little bit. It seems to let everybody relax”

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Quantitative Methods to *ASSESS*

Function: to *assess*

“...it’s more validated, it’s more dependable, it’s more solid data to base decisions on.”

- Occasionally quantification can help understand complex situations

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Methods to *COMMUNICATE*

Communication includes both QUAL & QUANT

“...lots and lots of numbers because if you go back to the engineer – in 90% of my projects there’s an engineer somewhere – and if we give them words, it doesn’t work. If we give them numbers, graphics, then ‘ahhh’, they understand.”

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Results: Process Tools

- Larger companies have begun to implement process tools:
 - Audits
 - Score-cards

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Results: Process Tools

'Score card' methods

"...[to] put ergonomics right up there with all the major metrics that are being measured...we have a separate score dot that is visible, not just embedded into the health and safety [score]"

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Results: Process Tools

'Audit' tools

"...typically a [low] score is not looked upon well from the president and, usually, a lot of times, the plant manager is being asked about (it), and they don't like being asked about it."

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Discussion: Relationships influence Methods

Established, trusting relationships:

- Qualitative may suffice
- Solution-building focus

New or sceptical relationships:

- Qualitative then quantitative
- Problem-convincing first
 - costs more time and \$

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Conclusions

Ergos discussed 2 modes of operation that are relationship dependant:

1. Solution building (when trusted)
2. Problem Convincing (for skeptics)

While #1 can be done with only qualitative info, #2 seems to require quantification of risk

- **Process tools** and performance metrics may bypass scepticism and help integrate ergonomics into design

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