

TNO-report
R2003970/4020053

Validating a Framework for Participatory Ergonomics

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Date
30 November 2000

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Netherlands Organization for
Applied Scientific Research (TNO)

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1. Introduction

The growth in participatory ergonomics over the past 15 years has been marked. Much ergonomics *practice* will necessarily always have been participative to some degree. However ergonomics research and interventions - especially concerned with work design and workplace improvements for health and safety - have increasingly and explicitly cited a participatory ergonomics approach and methods. Such growth has been fed by the recognition by companies of there being room for improvement in working methods (e.g. Vink et al., 1998) whilst not having resources to bring in ergonomics specialists for every need (Wilson, 1994), the increasingly participatory nature of approaches to industrial health and safety generally, and the related processes of the total quality movement (e.g. Eklund, 2000). Reasons to promote a participatory ergonomics (PE) approach include improved ideas and solutions, smoother implementation, better direct results and a number of systemic outcomes of value to the organisation or individuals or both (Wilson & Haines, 1997). Difficulties can be perceived time and cost, the effort needed to turn interventions into programmes, motivating participants and knowing how to embrace those represented but not active in the process - the non-participatory stakeholders.

Despite the vastly increased PE endeavours, there is still little in the way of an agreed theoretical structure for participatory ergonomics or a framework for practical advice and guidance. It is also difficult to compare across different PE projects, in terms of processes and of outcomes. In fact, the literature highlights participatory ergonomics as not being a unitary concept, but rather as an umbrella term covering a fairly broad range of ideas and practices. Recognising the diversity of PE, yet the need for better research and practice guidance, the Health and Safety Executive in the UK commissioned a guidance document; this defined a series of dimensions across which to describe PE initiatives, and presented a conceptual framework for PE from which practical guidelines could be drawn (see Haines & Wilson, 1998) and the framework also could help the growth of PE knowledge. At this moment it is difficult to compare different PE projects with each other and learn from each other. The framework and dimensions were based on previous work by the authors (e.g. Wilson, 1991; Wilson & Haines, 1997) and others (e.g. Cohen, 1996; Liker et al, 1989), and on the views of a number of European ergonomists who were interviewed during study visits. Importantly, the framework also drew upon related work in management and business administration (e.g. Cotton, 1993; Dachler & Wilpert, 1978).

A modified set of dimensions has now been produced as a conceptual framework for understanding PE. Although the primary aim has been to provide clarity and organisation for the field of participatory ergonomics, it is recognised that the approach could potentially play a role in the development of focused and practical guidance for the implementation of PE initiatives.

Any such framework requires validation before becoming the basis for guidance, but such multi-factor concepts as PE are not easy to validate. We have chosen to validate the framework within a structured exercise, involving case studies previously carried out by peers. The researchers on the case studies also - retrospectively - defined their own projects across the dimensions of the framework. Thus the frame-

work has been produced in the UK by two of the authors (first two) and been validated using cases in the Netherlands managed or supervised by the other two authors (last two).

This paper begins by describing the framework to be tested and the methods employed in the validation exercise. The results of the exercise are then presented and discussed, and implications are drawn for the development of the framework.

2. Participatory ergonomics: a conceptual framework for understanding

The framework which was tested in the validation exercise was that which was developed in work for the HSE (Haines & Wilson, 1998). It has nine different dimensions, each with two or more associated categories which define a feature of a PE initiative. Depending on their complexity, participation projects may consist of more than one type of participatory group (e.g. task forces, department level teams, steering committees), so for multi-level projects the framework should be applied separately to each different type of participatory group within the project. The framework is summarised in figure 2.1 and each dimension is described as follows.

Dimension	Categories
permanence	ongoing - temporary
involvement	full direct - partial direct - representative
level of influence	entire organisation - department/work group
decision making	group delegation - group consultation - individual consultation
mix of participants	operators - supervisors - middle management union personnel - specialist/technical staff - senior management
requirement	compulsory - voluntary
focus	designing equipment or tasks - designing jobs, teams or work organisation - formulating policies or strategies
remit	process development - problem identification - solution generation - solution evaluation - solution implementation - process maintenance
role of ergonomics specialist	initiates and guides process - acts as a team member - trains participants - available for consultation

Figure 2.1 Version of participatory ergonomics framework used in validation exercise

Dimension 1: permanence of initiative

The first dimension considers the permanence of participatory ergonomics within an organisation. Participatory ergonomics mechanisms may function on a temporary basis and may take place outside the normal organisational structures. Alternatively, ongoing participatory mechanisms may be developed which may well be much more integrated into the structure of the organisation.

Categories for performance: Temporary - Ongoing

Dimension 2: involvement

The second dimension of participatory ergonomics considers whether people participate directly or indirectly (via representatives). Dachler and Wilpert (1978) see direct involvement as “*immediate personal involvement of organisational members*” (p.12) Cotton (1993) goes on to describe this as “*typically face-to-face involvement where workers can have an immediate and personal impact*” and contrasts this with *indirect involvement which “incorporates some type of employee representation in*

which, rather than the employee interacting, his or her representative is involved”. (p.28)

Liker et al. (1989) utilise the distinction between direct and representative participation coined by Coch and French (1948) “*Direct participation means each employee participates directly in decisions about their own work. Representative participation means that employee representatives are selected to represent the viewpoints of a large number of workers.*” (p.187)

Examples of both direct and representative participation may be found in the participatory ergonomics literature. In developing this framework, it was important to look more closely at how the term representative may be interpreted. There seems to be two possible meanings. On the one hand, representatives may allow a wider group to participate by proxy (as in the case of elected representatives). Alternatively, representatives may not set out to actively represent the views of others, but instead participate because they represent a typical subset of a larger group. In order to recognise this latter form of representation a category has been introduced into this dimension, termed ‘partial direct participation’.

Categories for involvement: Direct participation - Partial direct participation- Representative participation

Dimension 3: level of influence

A further dimension considers the organisational level at which participatory ergonomics takes place. There are mechanisms which operate at the level of a department or work group, and there are cross-organisation mechanisms.

Categories for level of influence: Department / Work group - Entire organisation

Dimension 4: decision making power

The fourth dimension of participatory ergonomics considers the question: ‘Who has the power to make decisions?’ This is an important consideration as, although employees are frequently asked to express their views, in many participatory ergonomics initiatives the authority to make decisions still remains with someone other than the participants. In order to clarify this, the distinction made between consultative participation and delegative participation utilised by (amongst others) European Foundation for the Improvement of Living and Working Conditions the (EPOC Research Group, 1997) has been employed, as follows:

“consultative participation - management encourages employees to make their views known on work-related matters, but retains the right to take action or not.

Delegative participation - management gives employees increased discretion and responsibility to organise ... their jobs without reference back”

Categories for decision making power: Individual Consultation - Group Consultation - Group Delegation

Dimension 5: composition

The fifth dimension considers the occupational groups involved in the participatory process.

Categories for composition: Operators - Supervisors - Middle Management - Specialist/Technical Staff - Senior Management

Dimension 6: requirement

The sixth dimension of participatory ergonomics concerns the requirement for participation: Is it voluntary or compulsory? Although, in some cases, participation will be entirely on voluntary, some participatory ergonomics mechanisms such as quality circles or production groups require involvement in troubleshooting and continuous improvement as an obligation within job specifications.

Categories for requirement: Compulsory - Voluntary

Dimension 7: focus

The next dimension identifies the topics addressed by participants, and is self explanatory.

Categories for focus: Designing or specifying 'equipment' or tasks - Specifying work organisation issues - Formulating policies and strategies

Dimension 8: remit

The eighth dimension of participatory ergonomics describes the broad activities which fall within participants' remit, and by extension how extensive is their involvement in the change process. Process development refers to being involved in setting up or structuring the participatory process. Process maintenance refers to any involvement in monitoring or overseeing the progress of the initiative. Involvement in problem identification, solution generation and, perhaps, evaluation, means being part of the (continuous) improvement process.

Categories for remit: Process development - Problem identification - Solution generation - Solution evaluation - Solution implementation - Process maintenance

Dimension 9: role of 'ergonomic specialist'

The final dimension describes the nature of ergonomists' involvement in a participatory process. Many participatory ergonomics initiatives will involve an 'ergonomics specialist', although the roles they play in the process may differ and anyway can evolve over time.

Categories for role of specialist: Initiates and guides process - Acts as a team member - Trains participants - Available for consultation

3. The validation exercise

Testing the framework was undertaken during a two-day workshop at TNO's headquarters. TNO is a large applied scientific research organisation with a group of 25 ergonomists. There were a number of reasons why this organisation was a valuable test site. First of all, there was the practical convenience of their geographical proximity and English language skills whilst still providing some cultural contrast with the framework's developers. Secondly, it helped that they are enthusiastic about participatory ergonomics and are keen to exchange ideas with other researchers (although importantly, the specific work of individual staff members was not well known to the framework developers). Finally, and most importantly perhaps, they have undertaken a large volume of participatory work, much of which remains unpublished, and therefore this material had not previously been available for review by the framework developers.

A number of specific aims were identified for the validation exercise:

1. to obtain peer validation of the framework;
2. to examine how ergonomists and related professionals understand the components of the framework and to identify how this compares with the thoughts of the framework developers;
3. to investigate the usefulness of this general approach to conceptualising PE;
4. to examine whether cases can easily be classified using this framework and thus whether the framework could form the basis for a taxonomy of PE;
5. to assess whether the framework could support discussion and structuring of new projects by groups of experts;
6. to investigate whether the framework would benefit from further modification and if so, to identify the changes which should be considered.

The first day of the validation exercise involved the framework developers (first two authors) collecting data on a range of participatory projects undertaken by TNO. The project managers of seven separate PE projects, at the time of doing this research unpublished in English, were interviewed for about forty-five minutes each, using a semi-structured format (see appendix 1¹). None of the project managers had previously seen the framework and the interviews were designed to question project managers about their project on a general basis only, and not explicitly on the specific features of the framework. All of the interviews were recorded on audio tape and key responses were also noted on an interview pro forma sheet. Once all the interviews had been completed, the framework developer subsequently used the information gathered to position each project on the nine dimensions of the framework in preparation for the next stage of the validation exercise.

On the second day the framework was presented for the first time to the group of project managers who had been interviewed and to a number of their colleagues who had worked on one or more of the projects. The project managers work at TNO, with the role of acquiring new projects, setting these up with clients and guiding the subsequent PE process. Each of the dimensions and its associated categories were defined and further clarified in response to questions. Small teams were then formed,

¹ Not all the interview data gathered are reported in this paper.

composed of the project manager plus other relevant colleagues (who may have guided parallel projects - a process role - or solved specific ergonomics problems - a content role). Each team was asked to position at least one participatory group¹ from their own project on the framework using response sheets similar to the structure shown in figure 2.1. The response sheets were then used to examine consistency between project managers and framework developers in applying the framework to each of the projects tested. Finally, the results from the classification across one of the projects were presented to the entire group, enabling a themed discussion on the elements of the framework and the general usefulness of this approach to conceptualising PE. The validation exercise concluded with all group members being asked to assign an ‘importance score’ to each of the dimensions of the framework.

A summary of the projects examined during the validation exercise is provided in table 3.1. They encompass a range of different industries, from manufacturing and service sectors to construction and defence. The majority of the projects had “reducing physical workload” as one of their stated aims, however the means by which this was to be achieved varied somewhat between them.

¹ Participatory projects may consist of more than one type of participatory group (e.g. task forces, department level teams, steering committees etc.). Although the framework developers positioned all of the participatory groups identified within each project on the framework, due to time limitations project managers were invited to choose one of their participatory groups to locate on the framework. They were then asked to identify which group their analysis referred to.

Table 3.1 A brief summary of the seven projects examined

project	industry	project aims	groups involved
A	armed services	to undertake pilot projects with the aim of reducing heavy physical workload in order to increase number of female staff	project team and pilot teams involving: top and line management, human resources, employees, purchasing; external experts
B	community health and domestic care	to develop and implement an instrument to reduce physical load amongst home care workers	development groups and implementation groups involving: sector organisation; health and safety experts; top and line management; project leader; union representative; external advisors
C	installation industry	to reduce heavy work of operators installing heating, electrical systems, etc.	steering committee and departmental teams involving: line management; employee representatives; health and safety experts; internal and external advisors
D	chassis assembly of trucks	to reduce lead time, increase productivity and improve ergonomics	working group, steering group, assembly teams involving: production and engineering management; health and safety experts; line management; engineering; assembly workers and external advisors
E	daycare for children	to reduce physical workload for employees working with children	overall steering group and daycare steering group involving: regional and local management; employees
F	construction	to develop and publicise handling aids and other approaches to reducing physical workload amongst glaziers	steering committee and working group involving: sector organisation, glazing company management; union/employee organisation; employees internal and external advisors
G	tractor assembly	to reduce lead time, increase efficiency and improve ergonomics	task force involving: senior and line management; blue collar workers; production planning and external experts

4. Results

4.1 First level analysis

A first level of analysis was undertaken to identify whether the project managers and the framework developers were positioning each project in a roughly similar manner. The pattern of responses for each project are shown in tables 4.1 to 4.7 along with percentage disagreement scores (disagreement was noted when the project manager and framework developer did not select any of the same categories for a particular dimension). The aim of this first level of analysis was to identify areas where there is no overlap between the thinking of the two parties. For example, table 4.1 shows that for project A there was a very low level of disagreement between the framework developer and project manager. The only area where there was no overlap at all between the two views was for the dimension 'decision-making'.

Table 4.1 Pattern of responses for project A

dimension	categories	disagreement?
permanence	ongoing - temporary $\lambda\sigma$	—
involvement	full direct - partial direct - representative $\lambda\sigma$	—
level of influence	entire organisation - department/work group $\lambda\sigma$	—
decision making	group delegation λ - group consultation σ - individual consultation	✓
mix of participants	operators $\lambda\sigma$ - supervisors - middle management σ	—
	union personnel - specialist/technical staff $\lambda\sigma$ - senior management	
requirement	compulsory $\lambda\sigma$ - voluntary	—
focus	designing equipment or tasks $\lambda\sigma$ - designing jobs, teams or work organisation $\lambda\sigma$ - formulation policies or strategies σ	—
remit	process development - problem identification $\lambda\sigma$ - solution generation $\lambda\sigma$ - solution evaluation - solution implementation - process maintenance λ	—
role of ergonomics specialist	initiates and guides process $\lambda\sigma$ - acts as a team member λ - trains participants - available for consultation	—
disagreement score		1/9 = 11%

Key: λ = category chosen by project managers
 σ = category chosen by framework developers.

Table 4.2 Pattern of responses for project B

dimension	categories	disagreement?
permanence	ongoing σ - temporary λ	✓
involvement	full direct - partial direct - representative $\lambda\sigma$	–
level of influence	entire organisation $\lambda\sigma$ - department/work group λ	–
decision making	group delegation σ - group consultation λ - individual consultation	✓
mix of participants	operators - supervisors λ - middle management $\lambda\sigma$ union personnel - specialist/technical staff λ - senior management $\lambda\sigma$	–
requirement	compulsory $\lambda\sigma$ - voluntary λ	–
focus	designing equipment or tasks - designing jobs, teams or work organisation - formulation policies or strategies $\lambda\sigma$	–
remit	process development σ - problem identification λ - solution generation λ - solution evaluation - solution implementation λ - process maintenance σ	✓
role of ergonomics specialist	initiates and guides process $\lambda\sigma$ - acts as a team member - trains participants - available for consultation	–
disagreement score		3/9 = 33%

Key: λ = category chosen by project managers
 σ = category chosen by framework developers.

Table 4.3 Pattern of responses for project C

dimension	categories	disagreement?
permanence	ongoing - temporary σ	✓
involvement	full direct - partial direct - representative $\lambda\sigma$	–
level of influence	entire organisation $\lambda\sigma$ - department/work group	–
decision making	group delegation $\lambda\sigma$ - group consultation - individual consultation	–
mix of participants	operators $\lambda\sigma$ - supervisors σ - middle management σ union personnel - specialist/technical staff σ - senior management $\lambda\sigma$	–
requirement	compulsory - voluntary λ	✓
focus	designing equipment or tasks λ - designing jobs, teams or work organisation - formulation policies or strategies σ	✓
remit	process development σ - problem identification λ - solution generation λ - solution evaluation λ - solution implementation - process maintenance $\lambda\sigma$	–
role of ergonomics specialist	initiates and guides process σ - acts as a team member - trains participants - available for consultation $\lambda\sigma$	–
disagreement score		3/9 = 33%

Key: λ = category chosen by project managers
 σ = category chosen by framework developers.

Table 4.4 Pattern of responses for project D

dimension	categories	disagreement?
permanence	ongoing- temporary $\lambda\sigma$	—
involvement	full direct - partial direct σ - representative λ	✓
level of influence	entire organisation - department/work group $\lambda\sigma$	—
decision making	group delegation $\lambda\sigma$ - group consultation $\lambda\sigma$ - individual consultation	—
mix of participants	operators $\lambda\sigma$ - supervisors λ - middle management $\lambda\sigma$ union personnel - specialist/technical staff $\lambda\sigma$ - senior management	—
requirement	compulsory σ - voluntary $\lambda\sigma$	—
focus	designing equipment or tasks $\lambda\sigma$ - designing jobs, teams or work organisation $\lambda\sigma$ - formulation policies or strategies	—
remit	process development - problem identification $\lambda\sigma$ - solution generation $\lambda\sigma$ - solution evaluation λ - solution implementation $\lambda\sigma$ - process maintenance	—
role of ergonomics specialist	initiates and guides process $\lambda\sigma$ - acts as a team member λ - trains participants - available for consultation	—
disagreement score		1/9 = 11%

Key: λ = category chosen by project managers
 σ = category chosen by framework developers.

Table 4.5 Pattern of responses for project E

dimension	categories	disagreement?
permanence	ongoing - temporary $\lambda\sigma$	—
involvement	full direct - partial direct $\lambda\sigma$ - representative λ	—
level of influence	entire organisation - department/work group $\lambda\sigma$	—
decision making	group delegation - group consultation $\lambda\sigma$ - individual consultation	—
mix of participants	operators $\lambda\sigma$ - supervisors - middle management $\lambda\sigma$ union personnel - specialist/technical staff σ - senior management	—
requirement	compulsory - voluntary $\lambda\sigma$	—
focus	designing equipment or tasks $\lambda\sigma$ - designing jobs, teams or work organisation σ - formulation policies or strategies	—
remit	process development - problem identification $\lambda\sigma$ - solution generation $\lambda\sigma$ - solution evaluation - solution implementation $\lambda\sigma$ - process maintenance	—
role of ergonomics specialist	initiates and guides process $\lambda\sigma$ - acts as a team member - trains participants - available for consultation λ	—
disagreement score		0/9 = 0%

Key: λ = category chosen by project managers
 σ = category chosen by framework developers.

Table 4.6 Pattern of responses for project F

dimension	categories	disagreement?
permanence	ongoing- temporary $\lambda\sigma$	—
involvement	full direct - partial direct - representative $\lambda\sigma$	—
level of influence	entire organisation $\lambda\sigma$ - department/work group	—
decision making	group delegation $\lambda\sigma$ - group consultation σ - individual consultation	—
mix of participants	operators $\lambda\sigma$ - supervisors - middle management union personnel - specialist/technical staff σ - senior management $\lambda\sigma$	—
requirement	compulsory σ - voluntary λ	✓
focus	designing equipment or tasks $\lambda\sigma$ - designing jobs, teams or work organisation - formulation policies or strategies σ	—
remit	process development σ - problem identification $\lambda\sigma$ - solution generation λ - solution evaluation λ - solution implementation λ - process maintenance $\lambda\sigma$	—
role of ergonomics specialist	initiates and guides process $\lambda\sigma$ - acts as a team member λ - trains participants - available for consultation	—
disagreement score		1/9 = 11%

Key: λ = category chosen by project managers
 σ = category chosen by framework developers.

Table 4.7 Pattern of responses for project G

dimension	categories	disagreement?
permanence	ongoing - temporary $\lambda\sigma$	—
involvement	full direct - partial direct σ - representative λ	✓
level of influence	entire organisation - department/work group $\lambda\sigma$	—
decision making	group delegation λ - group consultation $\lambda\sigma$ - individual consultation	—
mix of participants	operators $\lambda\sigma$ - supervisors λ - middle management σ union personnel - specialist/technical staff $\lambda\sigma$ - senior management	—
requirement	compulsory $\lambda\sigma$ - voluntary	—
focus	designing equipment or tasks $\lambda\sigma$ - designing jobs, teams or work organisation $\lambda\sigma$ - formulation policies or strategies	—
remit	process development - problem identification $\lambda\sigma$ - solution generation $\lambda\sigma$ - solution evaluation λ - solution implementation λ - process maintenance	—
role of ergonomics specialist	initiates and guides process $\lambda\sigma$ - acts as a team member λ - trains participants - available for consultation λ	—
disagreement score		1/9 = 11%

Key: λ = category chosen by project managers
 σ = category chosen by framework developers.

4.2 Second level analysis

The aim of the second level of analysis was to look more closely at the level of agreement for each project across the framework as a whole and to provide a more in-depth indication as to how closely the project manager's view of the project matched the framework developers'. For this analysis a percentage agreement score

was calculated based on the number of categories selected by both the two parties. As the total number of categories ticked will influence the percentage agreement calculation, table 4.8 shows both the project manager's agreement with the framework developer and the framework developer's agreement with the project manager. Taking project A for example, the first percentage agreement score of 85% was based on the fact that, of the 13 categories selected as reflecting the project by the framework developer, the project manager's team agreed with 11 of these. The second percentage agreement score of 73% shows that the framework developer agreed with 11 of the 15 categories selected by the project manager.

Table 4.8 Agreement scores for the projects examined

project	percentage agreement		percentage agreement	
	(no. categories selected by PM/ no. categories selected by FD)		(no. categories selected by FD/ no. categories selected by PM)	
A	85%	(11/13)	73%	(11/15)
B	64%	(7/11)	44%	(7/16)
C	50%	(7/14)	58%	(7/12)
D	88%	(14/16)	82%	(14/17)
E	86%	(12/14)	86%	(12/14)
F	69%	(11/16)	73%	(11/15)
G	86%	(12/14)	63%	(12/19)

Finally, in order to look more closely at how each of the dimensions of the framework was interpreted, results from the seven projects were combined (see table 4.9). A 'strict agreement' score was calculated for each dimension, with agreement only being recorded where there was an exact match between the categories ticked by the project manager and the framework developer. For example, taking the first dimension 'permanence' where two possible categories could be selected, the framework developer and project manager selected the same category in five of the seven projects. However, for the dimension 'remit' where there were six possible categories to choose from, there was an exact match for categories selected in only one of the seven projects examined.

Table 4.9 Strict agreement scores for each dimension

dimension	number of possible categories	number of 'strict' agreements between PM and FD (across all 7 projects)
permanence	2	5/7
involvement	3	4/7
level of influence	2	6/7
decision making	3	3/7
mix of participants	6	0/7
requirement	2	4/7
focus	3	3/7
remit	6	1/7
role of ergonomics specialist	4	1/7

4.3 Importance rating for elements of the framework

In order to get a quantitative indication of how project managers viewed the relative importance of the different elements of the framework, they were asked assign a score to each dimension using the following scoring system: 0 = not important, 1 = important and 2 = very important. The results are shown in table 4.10.

Table 4.10 Importance rating by dimension

	'importance scores' assigned by each project manager												total	rank				
permanence	1	0	1	0	0	0	2	1	2	1	1	1	1	0	-	1	12	9
involvement	2	2	2	1	1	2	2	2	0	2	1	2	1	2	2	1	25	5
level of influence	2	1	0	1	1	2	0	1	2	1	1	2	1	1	2	1	19	7
decision making	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	31	1
mix of participants	2	1	2	1	2	2	1	2	1	2	2	2	2	2	2	2	28	=2
requirement	1	2	1	0	1	1	1	1	0	1	2	1	1	1	-	1	15	8
focus	2	2	2	2	2	1	2	2	1	1	1	1	1	0	-	0	20	6
remit	2	2	2	2	2	1	2	2	2	2	2	2	2	2	-	2	28	=2
role of ergonomics specialist	2	2	2	2	2	2	2	2	2	2	2	2	2	2	-	0	27	4

5. Discussion of results

The results tabulated above are discussed in the following sections. Results are examined firstly by individual project and then for each dimension of the framework.

5.1 Results by project

The first level of analysis (tables 4.1 to 4.7) identified that, for the majority of the projects (5 out of 7), the views of the project managers and the framework developer showed some degree of overlap in at least eight of the nine dimensions of the framework. The remaining two projects (projects B and C) showed more disagreement with no overlap in views recorded for three of the nine dimensions.

The second level of analysis looked at the match between the project manager and framework developers' view of each project more closely, through the calculation of a percentage agreement score for all categories across dimensions. As has already been mentioned, the total number of categories selected will influence the percentage agreement calculation. For four of the projects, the total number of categories selected by the project manager exceeded that of the framework developer, for a further two projects the converse was true, and the remaining project had equal numbers of categories selected by both the project manager and the framework developer. The slight tendency for project managers to select more categories may be partly related to the framework developers' view that some of the dimensions are composed of mutually exclusive categories. Alternatively it could be related to the project managers' more in depth knowledge of the projects. This issue is expanded further in the discussion section.

In general the level of agreement was quite high (see table 4.8). It varied from 88% to 50% (project manager agreement with framework developer) and 86% to 43% (framework developer agreement with project manager). Looking at the lower scoring projects, one of these - project A - was a complicated mixture of instrument development and implementation and was less well understood by the researcher than were some of the higher scoring projects. The other low scoring project, project C, was a complex initiative at a company of 7,000 employees. Some staff, middle management and supervisors were involved, but most of the project was carried through by senior management. Unambiguous classification of this project was very difficult.

Although these results give a general indication as to how uniformly the project manager and framework developer applied the framework, in order to look for systematic differences in how the framework was understood, it is necessary to consider the results across each dimension.

5.2 Results by dimension

The combined strict agreement results of the seven projects (table 4.9) highlighted areas of particular disagreement between project manager and framework developer responses. Five of the nine dimensions failed to reach a 50% 'strict agreement' level

although, probably not surprisingly, three of these (mix of participants, remit and role of ergonomics specialist) are also the dimensions with the greatest number of possible categories. Examining the pattern of results (tables 4.1 to 4.7) provides further insight into areas of (mis)understanding. In some cases these interpretations are supplemented by notes made by project managers on their response sheets or raised during the group discussion session.

5.2.1 Permanence

There appeared to be relatively few problems with identifying whether a project was ongoing or temporary (five agreements out of a possible seven). For the remaining two projects, managers felt that mutually exclusive categories did not fit their projects well, since they were seen as temporary at the outset but with the aim to develop into continuing projects. For instance, in project C a mechanical aid was developed to transport glass and complete windows; the use of this aid is on-going whilst the development was a particular exercise.

5.2.2 Involvement

There was agreement between the researcher and project manager for four of the seven projects. For the remaining projects, disagreement arose over the distinction made between partial direct and representative participation. It may be that these particular terms were not sufficiently clear; through discussion, project managers agreed that there was a need to distinguish between participants who represent themselves as a typical member of the workforce and those whose role is to actively represent the views of a group of their colleagues.

5.2.3 Level of influence

This dimension achieved the greatest number of strict agreements (six out of a possible seven). However one project manager pointed out that this dimension did not accommodate projects that had influence beyond one particular organisation. Sometimes a PE initiative has a focus on an industry sector (e.g. project F).

5.2.4 Decision making

There were some difficulties with the dimension of decision making, with strict agreement being reached for only three of the projects. Disagreements seemed to arise largely because the framework developers had intended this dimension to refer to the decision making power of the group as an entity whereas some of the project

managers made a distinction between the decision making power of different group members. Some project managers also highlighted the fact that the power to make decisions might be related to the remit of the group. For example, the responsibility to identify problems may be delegated to a group although the decision to implement changes may well be retained by higher management. In addition the distinction between individual and group consultation is not easy; when do a small number of individuals become a group.

5.2.5 Mix of participants

This dimension achieved the lowest number of strict agreements (none across the seven projects examined), seeming to stem largely from differences in terminology used within UK and Dutch industry. In particular, the distinctions between the categories ‘supervisor’, ‘middle management’ and ‘senior management’ may have cultural differences. In addition, the categories available within this dimension were identified as being too limited to accommodate the range of people who participated in some of the projects.

5.2.6 Requirement

There was agreement between the framework developers and project managers for four of the seven projects, and some difficulties with this dimension did arise. In particular they reflected the recognition by both the framework developers and project managers that in some cases the requirement to participate may be related to the participant’s function and therefore will not necessarily be the same for all members of the group.

5.2.7 Focus

It is not clear why this dimension did not achieve a greater number of strict agreements (only three out of a possible seven). It could be that the implied distinction between a physical category (‘designing/specifying equipment or tasks’) and a work organisational category (‘designing jobs, teams or work organisation’) was not always appreciated by the project managers; there is considerable overlap between the notions of tasks and job.

5.2.8 Remit

The term ‘remit’ itself was not generally understood by the Dutch project managers. Beyond this, the low number of agreements across this dimension (one out of a pos-

sible seven) seemed to be related to the distinction made between the categories 'solution generation', 'solution evaluation' and 'solution implementation'. Some project managers felt that the category 'project evaluation' should have been included for this dimension.

5.2.9 Role of ergonomics specialist

The dimension 'role of the ergonomics specialist' threw up some problems, with strict agreement being reached for only one of the projects. For the project managers, the role of change agent and ergonomics specialist may well be undertaken by different people and this seemed to influence how they understood this part of the framework. In addition, feedback indicated that one of the categories for this dimension should clearly identify those instances where the specialist's role is to act as an expert in his/her field.

Table 4.10 shows that project managers rated five dimensions of the framework as particularly important in defining a project, 'decision making', 'mix of participants', 'remit', 'role of ergonomics specialist' and 'involvement'. Some of the project managers argued that the entire framework should be viewed as a package and that these ratings should not be used as the basis for discarding any of the dimensions, which is what was intended by the developers.

6. Implications for the PE framework

The results of the validation exercise indicate that the framework provides an acceptable and successful approach to capturing the diversity of a range of PE projects. The framework was generally received positively by the project managers who felt, in particular, that it could form a useful tool at an early stage of project negotiation. Through discussion, it was agreed that there are a series of choices to be made in any project and that the organisational context is the key to these. However, it was felt that these choices are not always made sufficiently explicit, and that the framework may act as a form of a checklist to ensure that the issues and options are made clear to all parties at the outset.

For any framework to be useable in practice it must be easily understood and widely applicable. It is acknowledged that there were potential limitations with the validation exercise - most notably because it required the framework developers to understand quickly a range of non-UK projects through relatively short, intensive interviews - but it did enable the framework developers to identify a number of ways in which the framework's usefulness and generalisability might be enhanced. The modifications which have now been made and the revised framework are described in table 6.1.

Table 6.1 A summary of modifications to the framework identified by the validation exercise

dimension*	modification	revised categories
permanence	None	ongoing - temporary
Involvement	Replace the categories 'partial direct' and 'representative' participation with the categories 'direct representative participation' (i.e. a sub-group of possible participants) and 'delegated participation'	full direct participation - direct representative participation - delegated participation
Level of influence	Divide the categories 'department/work group' into 'department' and 'work group/team'. Add category 'group of organisations'	group of organisations - entire organisation - department - work group/team
Decision making	Identify that decision making power may be linked to the group's brief and that decision making power may not be equal amongst group members (link to mix of participants - see footnote*)	group delegation - group consultation - individual consultation
Mix of participants	Simplify management categories into 'line management' and 'senior management'. Add categories 'external advisor', 'supplier/purchaser', 'industry organisation' and 'internal specialist/technical staff'. Include link to decision making (see above)	operators - line management - senior management - internal specialist/technical staff - external advisor, supplier/purchaser - industry organisation
Requirement to participate	Identify that requirement to participate may be related to job function and therefore may vary between group members - see footnote*	compulsory - voluntary
Focus - rename as topics addressed	Re-label category 'designing equipment or tasks' as 'physical design/specification of equipment/workplaces/work tasks'	physical design/specification of equipment/workplaces/work tasks - design of jobs, teams or work organisation - formulation of policies or strategies

dimension*	modification	revised categories
Remit - rename as brief	Collapse categories solution generation and solution evaluation into 'solution development'. Replace category 'solution implementation' with 'implementation of change'. Re-label 'process development' as 'set up/structure process' and 'process maintenance' as 'monitor/oversee process'. Include link to decision making (see above)	problem identification - solution development - implementation of change - set up/structure process - monitor/oversee process
Role of ergonomics specialist**	Replace category 'acts as team member' with 'acts as expert'. Add category 'not involved'.	initiates and guides processes - acts as expert - trains participants - available for consultation - not involved
Possible additions to framework	Refer to embedded group structure (not a dimension) as having: one layer (working group) two layers (working group and steering group) three or more layers Refer to the boundary of the project (possible categories: none - loose/flexible - tight/defined)	

* It is now recognised that in some cases dimensions of the framework may be linked. It will be useful in the future to add tools to support the framework, which identify how these linkages may operate.

** This dimension specifically looks at the role of ergonomics specialists within the participatory process. It is recognised that in some cases a change agent (who is not necessarily an ergonomics specialist) will be involved in the process - something which might be identified using the earlier dimension 'mix of participants'.

7. Conclusion

This paper describes efforts to provide structure to the increasingly prevalent participatory ergonomics (PE) initiatives. Since many reports of PE projects extol the virtues of the approach and suggest relative success, it may seem that no structure or fundamental understanding is required. However, we believe that reported successes are often only partial reports and rarely can be transferred to other settings, that one-off cases are not usually translated into the potentially more powerful company-wide programmes, and that better guidance on PE process and methods is required to motivate and support companies and even ergonomics practitioners. For this reason, we developed an original version of a PE framework for the Health and Safety Executive.

The validation of this framework, reported here, is a rare example of formal peer review of such developments in ergonomics. The exercise had a series of aims related to evaluation of the framework, its usefulness and its improvement. The reasonable level of agreement when using the framework to classify PE cases gives crude support for its validity, and the improvements made to the revised framework should enhance this. Generally, peer review of the framework showed it to be understandable and complete, and it could be used to classify seven different PE cases. This suggests that the revised version could form the basis of a PE taxonomy. The project managers at TNO believe that the framework will prove to be a valuable tool in establishing and agreeing an agenda amongst stakeholders at the outset of new PE projects. Finally, we hope that the framework makes a contribution to the better understanding of what is involved in participative processes for ergonomics change, and also to the development of appropriate methods, measures and criteria for evaluation.

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Appendix 1 Semi-structured interview schedule

First of all, some background information

- What was the aim of the project?
- Can you give a brief description of the project?
- What factors were important in the decision to implement PE?
- How was participation arranged? (diagram?)
- How did the initiative fit within existing organisational structures?
- What factors were important in deciding how the initiative would be arranged/ designed?
- Did you have a plan at the outset?
- Did you depart from this and if so, why?
- How was support from within the organisation established?
- Did you encounter any obstacles to gaining support?

Next, some more questions about how the project was structured

- First of all, who participated?
- Did all people likely to be affected by the project participate or were some participants acting as representatives of others?
- How many people participated?
- Which Occupational groups?
- Were they internal/external to organisation?
- How did people become participants?
- Was all participation through groups?
- How many groups?
- How did they differ?
- What role did ergonomists play in the process?

The next set of questions are about the tasks undertaken by participants

- What topics did the participatory initiative address?
- Did these change over time?
- What were participants (groups) asked to do?
- Did participants have influence over things beyond their own immediate working environment?
- What methods were used by participants to fulfil their remit?
- What factors influenced the methods chosen?
- Who had the power to make decisions?
- How long did the project last?

Finally, some general questions about the project

- What were the outcomes from the project?
- Did you encounter any obstacles to progress at any stage of the participatory process?
- What factors were important in influencing the success of the project?
- What did you learn from the experience?

