

# **Strategies of International Cooperation in an International Project: Advantages and Pitfalls**

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*The MEPS (musculoskeletal—eyestrain—psychosocial—stress) study involved an extensive degree of multidisciplinary and multicultural cooperation. The objective was to examine the effects of multiple ergonomic interventions on visual, musculoskeletal, postural, and psychosocial outcomes amongst operators of visual display terminals (VDTs). The inherent complexity of a comprehensive ergonomic investigation requires participation of researchers from a variety of disciplines, as well as comparisons among populations with different geographical and cultural backgrounds. The design and execution of the resulting research protocol presents a number of challenges. This paper discusses the advantages and pitfalls associated with multidisciplinary multinational cooperation. Advantages include the necessity for development of a common language and perspective providing a basis for future collaboration. Pitfalls include logistic and coordination difficulties associated with conducting standardized procedures in different locations, as well as the inherent potential for professional conflict. It is argued that such pitfalls ought to be understood and integrated into the project planning process.*

ergonomic intervention   multidisciplinary   multicultural   VDTs   office ergonomics

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## **1. INTRODUCTION**

This paper describes the experience of conducting a multidisciplinary, multinational ergonomic study known as the MEPS (musculoskeletal—eyestrain—psychosocial—stress) project. The objective of this study was to examine the effects of various kinds of ergonomic interventions, including corrective lenses, on a combination

of musculoskeletal, postural, and psychosocial outcomes amongst operators of video display terminals (VDTs). The methodology is described in this issue [1]. Results from study sites in four different countries are also presented in this issue [2, 3, 4] and in Westlander et al. [5]. In this paper, we discuss more global issues relating to the process of international cooperative efforts.

## 2. GOALS

In order to accomplish the overall goals of the study, it was necessary that the general approach be multidisciplinary in nature, and that the results be comparable. With regard to the first goal, the inherent complexity of a comprehensive ergonomic investigation required participation from health care specialists, ergonomists, social psychologists, work physiologists, eye care specialists, and statisticians. With regard to the second goal, conclusions from intervention studies require comparable results from populations with different geographical and cultural backgrounds. To be able to compare results across countries as well as different kinds of organizations, it was necessary to employ:

1. a common research protocol;
2. common standardized methods and questionnaires;
3. strict definitions of measured variables;
4. comparability of measurement procedures through written description, video presentation, and hands-on training;
5. strict definitions of health outcome criteria.

Data analysis procedures required the same efforts. It was essential that the relationship between the design of the study and the statistical methods to be used be decided during the design period of the study.

## 3. ADVANTAGES

### 3.1. Establishing and Maintaining Teamwork

It is axiomatic that an effective ergonomic intervention must be multidisciplinary. Recent critical reviews [6, 7] have emphasized the multifactorial nature of such interventions and the necessity of clearly specifying the interactions involved. For a multidisciplinary project to be effective, however, it is essential that participating members are willing to develop a spirit of cooperation with their colleagues on the project team. Consequently, multidisciplinary research

necessarily provides a learning situation in which team members can expand their own professional and personal development. This development can be reflected through an increased awareness of the ways in which knowledge from several different disciplines interacts as the team proceeds towards the goal of evaluating complex causation of outcomes.

In a very practical sense, each member of the team must learn the art of compromise with respect to their own disciplines. Multidisciplinary interventions require that the development of a comprehensive protocol be administered within a limited time span. Thus, while individual team members will naturally want to be comprehensive and inclusive with respect to assessing outcomes within their own professional disciplines, they must also become aware of how their own disciplines must be dependent on others in attaining a global understanding of complex work environments. Overlaid on this requirement must be a further awareness of national cultural differences as well as differences in professional orientations. Thus, the overall process requires considerable good will and negotiation. The outcome, however, is invaluable in that a basis for future cooperative relationships is established.

It is of some interest that this problem is not restricted to the field of ergonomics. Galison [8] has provided an intriguing study of the development of the field of microphysics, from the 19th century cloud chamber to the factory-like laboratories of the present day at places like CERN (European Organization for Nuclear Research), Stanford and Berkeley, CA, USA. His particular focus is on the way in which the development of laboratory apparatus transformed the social/organizational structure of microphysics from individual investigators working alone or in small groups with total control and understanding of their apparatus, to industrial-style organizations requiring collaboration among many professionals. In order for this collaboration to have occurred, Galison invokes the concept of "trading zones". Derived from the field of linguistics, trading zones refer to simplified languages that arise when adjacent cultures require a mutually understandable means of communication in order to transact business.

Ultimately, such languages must be developed for multidisciplinary cooperation to occur, since it is not possible for team members to be specialists in each other's discipline. This can be accomplished through seminars and practice sessions.

### 3.2. Database Development

A multinational multidisciplinary investigation requires the establishment of a centralized database containing results from all participating countries in a common format. This is essential in facilitating a relationship between causative factors and health outcomes. Potentially confounding and/or moderating variables related to organizational, psychosocial and individual factors can be identified and controlled for in the statistical analysis. It is, therefore, also necessary to establish a centralized secretariat for database administration and statistical analysis.

## 4. PITFALLS

As stated earlier, investigations of ergonomic interventions must have a multidisciplinary approach in order to be successful. Adding a multinational component greatly increases the generalizability of the investigation. Hence, multinational multidisciplinary cooperation produces many positive benefits. At the same time, there are also a number of inherent pitfalls which must be realized and explicitly planned for.

### 4.1. Teamwork Problems

A major problem is simple logistics. It is difficult and expensive to attempt to coordinate the work of different people at different physical locations. In addition, the very advantages of international multidisciplinary work entail a primary difficulty in that team members have differences in both professional and cultural orientation which may need to be understood and worked with. Finally, there are individual variations in team members with respect to capabilities to cooperate and be flexible. These abilities are at least as important as technical competence for project success.

### 4.2. Protocol Issues

The research protocol must be developed with attitudes of compromise from all participants. Difficulties experienced during the MEPS project arose from the following sources.

#### 4.2.1. *Different research models as a basis for designing the study*

Research models are often different depending on the participating discipline. For example, requirements for sample sizes to achieve sufficient statistical power are quite different for electromyography (where many hundreds of data points are collected within an hour) compared with questionnaire methods (where a daily administration of the questionnaire results in only one data point per item).

#### 4.2.2. *Agreeing on a standardized intervention*

Ideally, we would have desired the same ergonomic intervention at each worksite. However, this was not practical. Insofar as each national study was required to obtain its own funding, the management of each study site had different ideas as to what intervention was appropriate or possible. The only exception was for the case of optometric correction, which was provided for all three intervention sites. In fact, at one site (Poland), the research team was not given control of more expensive changes during intervention time (i.e., the computer equipment exchange).

This may have negatively impacted the effectiveness of the intervention. Nevertheless, it was a significant achievement to simply be able employ a standard assessment protocol at each individual site.

#### 4.2.3. *Management cooperation in data collection*

The research protocol specified that data should be collected within the agreed-upon time frame specified. However, getting acceptance from the management of the various worksites to comply with the protocol was not always possible due to operational constraints. In the extreme case of the

Swedish component, the study site was dissolved for economic reasons in the midst of the study. Hence, the Swedish data is not part of the MEPS database, but is reported separately.

### 4.3. Standardized Methods and Questionnaires

Both professional and cultural differences required that attention be paid to a number of methodological issues not normally encountered in more traditional research investigations. Accordingly, several seminars and practice sessions were conducted to obtain as much consistency as possible within the different teams.

#### 4.3.1. Multinational use of questionnaires

While the questionnaires were developed in the English language, they needed to be translated into the languages of the national studies. The validity of the questionnaires may have been compromised by the translation process. In addition, even in English, there were linguistic nuances and idiomatic expressions reflecting cultural differences which may have had impact on validity. Furthermore, there were some items in the psychosocial questionnaire which were not culturally acceptable as written in some countries which had been scheduled to participate in the study. (The primary reason for lack of participation, however, was financial.)

#### 4.3.2. Clinical examinations

An attempt was made to standardize methods of performing clinical examinations by video tape presentations which were circulated among participating medical specialists. It became clear that these tapes, alone, were not sufficient. Eventually, more detailed communication among medical colleagues by phone and letter was necessary.

#### 4.3.3. Postural load and angle measurement

Electromyographic (EMG) and electrogoniometric procedures used for postural load and angle measurements were also demonstrated on

video tapes and circulated among participating investigators. The need for hands-on practical training, however, became obvious. Several days were used for training researchers in each step in the measurements and analysis procedures. Such training consisted of electrode and goniometer/inclinometer placement, calibration procedures, measurement procedures, and criteria for acceptable results in the data analysis.

However, despite common training, differences in examiners can lead to differences in results. In the MEPS study, we saw that the Maximum Voluntary Contraction (MVC) during the calibration procedure of EMG showed a great difference between the women in Poland and Norway. This difference is difficult to accept as a real difference of strength. A more likely explanation can be attributed to differences in motivation generated by the examiners during the measurement of MVC. In addition, the time available for the subjects to be measured (which is often constrained by management) may influence the results of the measurements. Sometimes the calibration of the EMG procedure may be time consuming. The resulting stress on the subject might yield an unacceptable measurement. (It might be noted that this is problem is not unique to this investigation. Galison [8], in discussing research on fundamental particles in physics, reports failures to replicate findings between laboratories as a result of different methods of processing film emulsions.)

#### 4.3.4. Optometric measures

The optometric examination was demonstrated on video tapes which were circulated among investigators. However, it was not possible to carry out practical training of examiners. There were, however, opportunities for discussions between the different examiners.

### 4.3. Criteria for Health Outcomes

Certain criteria for musculoskeletal illness were related to symptoms such as pain or discomfort in the musculoskeletal system and standardized clinical signs found by examination. These included the number of trigger points in the

muscles, pain during or shortly after provoking standardized muscle tests, and restriction of movements of the joints. Visual discomfort and headache were subjectively reported on validated Visual Analog Scales. These measures should have been relatively consistently applied across countries.

However, this might not have been the case with another parameter used to estimate the seriousness of musculoskeletal illness; namely sick leave. Rates of musculoskeletal sick leave might be expected to vary according to the nature of the workers' compensation insurance systems in each country. For example, a higher sick leave rate may be expected in Scandinavian countries, which have higher compensation rates.

Finally, although providing optometric corrections to participants was accomplished as part of each intervention, specification of standardized criteria for optometric corrections has been difficult due to the variability in optometric practice among different countries.

#### **4.4. Loss in Statistical Power Due to Lack of Participation**

The statistical analysis model originally developed in support of research protocol assumed that several additional national study sites would contribute to the database. Unfortunately, because of financial constraints, these sites were not able to participate in the study. Accordingly, it was not possible to employ the powerful multivariate analysis tools which had originally been planned because of the corresponding reduction in sample size and statistical power.

In this regard, it might be pointed out that even for the national sites participating in the study, the question of maintaining sufficient sample size is a challenge. To satisfy the inclusion criteria for each study group required a minimum of 23 participants who performed the same work tasks, who would agree to remain in their present job position for approximately 18 months, and, in the case of female participants, did not become pregnant. The U.S. study site, for example, consisted of thousands of data entry and dialogue workers, but it was quite difficult to find a sample which

matched the aforementioned criteria. This will, of course, be a problem in any field investigation.

## **5. CONCLUSIONS**

Success of an ergonomic intervention study is enhanced in depth and breadth of understanding when the intervention team is multidisciplinary and thus explores different vantage points available within the team. Hence, the advantages of multidisciplinary cooperation in scientific investigations of such interventions should be obvious. If, in addition, a multinational component is added, the investigation gains value in terms of its capability to draw more general conclusions based on populations with different geographical and cultural backgrounds. However, there are significant pitfalls associated with the combination of multidisciplinary and multinational investigations. It is essential that these pitfalls be identified prior to commencement of the project.

Some of the pitfalls inherent to the nature of collaborative investigation, others can be considered primarily logistical in nature. Individual researchers will naturally want to concentrate on their own disciplines. Collaborative research explicitly requires a personal commitment on the part of each investigator to develop the kind of common language just described [8]. Without this commitment, the project will likely collapse. With it, a set of common goals can emerge and the team can progress towards an integrated research protocol. This commitment is, of course, even more important when the team faces cultural as well as professional differences.

The logistical difficulties are conceptually simpler to deal with since they can typically be resolved with additional resources (primarily financial). The MEPS project would have been more effective if a single coordinated funding source had been available. We might then have proceeded by first identifying functionally similar study sites in different countries. Since the sites were similar, we could reasonably (within the professional guidelines of ergonomic best practices) offer each site manager the same ergonomic intervention. Since the cost of the intervention would be borne by the project rather

than site management, it is likely that cooperation would be easier to obtain. Accordingly, it is more likely that the appropriate multivariate statistical analysis could have been accomplished. Moreover, adequate funding would have allowed for a sufficient number of training and coordination sessions so that the procedural differences just described would have been at least minimized.

In reality, the funding requirements for this idealization would have been considerably greater than funds which were actually available. Nevertheless, is there a realistic alternative? The scientific adequacy of the current literature on ergonomic interventions has been questioned [5, 7], and the world-wide cost of musculoskeletal disorders is extensive. Carefully done multidisciplinary multinational investigations are not simple to accomplish, but the benefits—both scientific and practical—far outweigh the costs.

Nevertheless, with all of the problems of the current study, it can be argued that the outcomes, although incomplete, are extremely valuable. A baseline of knowledge, both informal and formal, now exists which would enable future research to proceed with fewer pitfalls. The overall findings, moreover, could be held to be generally supportive of the effectiveness of ergonomic interventions. In particular, of the three sites, the most extensive ergonomic redesign (USA) resulted in the clearest improvement; and the most problematic intervention (Poland) where the investigators did not control more expensive changes during intervention time (i.e., the computer equipment exchange) led to the most ambiguous outcomes. In the intermediate case, an already well-designed workplace received a relative small intervention; resulting in relative minor changes in outcome measures.

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