

Polarisavenue 151
P.O. Box 718
2130 AS Hoofddorp
The Netherlands

www.arbeid.tno.nl

T +31 23 554 93 93
F +31 23 554 93 94

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**Ruud Nelemans, Noortje Wiezer, Fietje Vaas, Johan
Gort, Jop Groeneweg***

TNO Work & Employment

**University of Leiden, Centre for Safety Research*

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TRIPOD SIGMA. RESULTS OF A PRO-ACTIVE WORK STRESS-SURVEY.

Ruud Nelemans, Noortje Wiezer, Fietje Vaas, Johan Gort,
Jop Groeneweg*
TNO Work & Employment
*University of Leiden, Centre for Safety Research

Work related stress is one of the most important causes of disability and absenteeism. It can cause a decline of motivation and productivity. TNO Work and Employment has developed an instrument, called Tripod Sigma, that identifies risks to work stress and provides tools for remedying these risks. The Tripod Sigma model is developed analogous to the Tripod Delta model which Shell has initiated to identify and pro-actively control safety risks. This model, developed by the University of Leiden and Manchester, is used to measure latent failures in the working environment that can cause human error. The main philosophy behind Tripod Delta is that human error can most effectively be controlled by controlling the working environment and the organisation of work. Work stress, like human error, is something that occurs on the level of the individual. Research shows that causes that contribute to work related stress can also be traced back to conditions of the working environment of employees. The project described in this paper has the aim to develop an instrument for analysis of risks for work related stress 'all the way back' to the level of management decisions. An instrument that not only identifies risks, but also provides direct tools to reduce or prevent risks.

Introduction

Work-related stress is one of the most important causes of disability and absenteeism. Moreover work-related stress can influence an employee's performance and company loyalty in a negative way. Research shows that 29 % of the workers in Europe experience stress - and 22% experience fatigue due to work (Houtman ea 2001). More and more work-related stress is considered as a substantial problem throughout companies in Europe.

Although work related stress involves the mental and physical state of an individual, a 'sound organisation' is the best way to prevent it and to guarantee an optimal performance (Vaas, 1995). Shell¹, considers work-related stress a prominent health risk. They were seeking tools that will enable line managers to proactively manage the root causes of stress in order to reduce stress at work and to remove factors which prevent an optimal work performance. Shell asked TNO Work and Employment to develop an instrument

which will help Shell line managers to identify and assess the General Failure Types that cause work-related stress and prevent optimal work performance. An instrument that should be developed analogous to the Tripod Delta instrument used to identify and pro-actively control safety risks. Tripod Delta is used within the Shell company a number of times and widely accepted by management as a useful and workable tool. The new developed instrument is called Tripod Sigma. With this instrument two pilot studies are conducted. In this paper the instrument and the results of these two pilot studies are described.

The Tripod philosophy

Accidents are often attributed to human error. Accident analysis however points out that contributing causes of accidents can be traced back to elements of the working environment and eventually to management decisions.

The main philosophy behind Tripod is that human error can most effectively be controlled by controlling the working environment and organisation. In Tripod the environmental conditions that cause human error are called 'latent failures'. These failures are organised into so-

¹ For the purpose of improved readability, the term 'Shell' will be used instead of 'The Royal Dutch/shell Group of Companies'.

called General Failure Types (GFTs). What is measured with the Tripod Delta survey is the level of control an organisation has over each GFT. The survey results show whether there are deficiencies in the business process and where these deficiencies are. By remedying these deficiencies, management can prevent human error and business upsets. In other words, the Tripod Delta survey examines conditions within the working environment that increase the risk of human error and business upsets. Changing these conditions is the most effective and efficient way of preventing human errors from occurring (Groeneweg, 1998).

The TNO approach to work-related stress and performance is based on scientific theories about the relationship between the division of labour (organisational structure, culture and business process design), work-related stress, and learning (Project Group WEBA, 1989; Klein Hesselink, 2001). The philosophy behind the TNO approach to work-related stress and ill performance is basically the same as the Tripod philosophy. Although work-related stress and performance, like human error, occur on the level of the individual, the TNO approach is based on the notion that the focus should not be on the individual employee but on the work conditions of this employee and the deficiencies in the business process behind these conditions. Like the Tripod Delta survey, the TNO approach examines the causation chain in the working environment that increase the risk of (in this case) work-related stress and ill performance. Changing these conditions is the most effective, efficient and structural way to prevent work-related stress from happening and to improve performance in the first place.

A new tool?

The Tripod Sigma instrument has two aims: it should help management to identify and assess the General Failure Types that cause work-related stress and prevent optimal work performance. But it should also identify steps to be taken to decrease the risks on work-related stress and sub-optimal work performance. Where other instruments can be used only to detect risks on work-related stress, this instrument goes back into the causation chain all the way to the management decisions that allowed these risks to occur. By identifying these decisions not only the risks that can cause work-related stress and sub-

optimal performance are identified, but also the steps that can be taken to decrease these risks. The instrument on its own should stimulate action. Eventually this instrument will be an instrument to support consultancy projects.

Towards the tripod sigma model

Stress, concepts and relations

Stress is a mental and physical state. Work-related stress can have a negative effect on the employees performance and commitment to his work and the organisational unit. **Work-related stress** is stress caused by a lack of control experienced at work (Cox et al., 2000). Work-related stress can be decreased and performance improved by increasing control. This can be achieved through mental training (e.g. cognitive-behavioural training) that improves the worker's coping style, on the one hand. On the other hand, an important prerequisite for a successful coping strategy is the structural presence of **control options** in the work situation (Project Group WEBA, 1989). And this is what needs to be studied to prevent employees from being exposed to the risk of work-related stress and resulting impaired performance. Opportunities to control the major risks contributing have to be developed if the aim is to create an optimal working situations with challenging jobs and good organisation results. The only way this can be done is by changing the design and management of how the work is organised.

The parallel with safety management is clear. A person must behave safely and can be taught to do so. However, the first responsibility of the employer is to create a safe working environment by improving the design and management of the way the work is organised. So, the next question is, 'what are the basic risks or General Failure Types and what control opportunities do employees need to cope with these risks?'

Research shows that there are four main categories of problems over which a person can feel that he/she has less control (Veerman et al, 2000):

1. **Job Demands**, caused by high demands, time constraints and disturbances / breakdowns in production.
2. **Work-life balance**: too much interference of work with private life, demands from the

- sphere of work time and presence that are difficult to combine with private care obligations
3. **Working relations:** such as social support, co-operation, and coaching on the positive side; and conflicts, mobbing and discrimination on the negative side.
 4. **Working conditions:** such as contracts, job security, opportunities for learning, management development, and career planning.

Culture can interfere with control opportunities. A corporate culture can be a stimulating or an inhibiting factor. In a corporation the culture may stimulate autonomy, participation, negotiation and coaching. Alternatively, a corporation's culture may prevent employees from making use of these opportunities. If there is a shared understanding in an organisation that you do not bother the boss with your problems, then the opportunity to consult him/her when problems occur may be present, but will not be used. If the common value in the organisation is that organisational interests are a legitimate reason for interfering with a person's private life then the opportunity to discuss workload, with the aim of keeping a good work-life balance, will not be used, either.

The culture of a group (or organisation) can be defined in terms of values and assumptions (notions about what is right and wrong, about how the world should be, do's and don'ts), and perspectives on situations that are shared by members of the group. Sometimes these values are formalised in rules, incentives and targets, at other times they exist despite the formal rules.

To conclude, an instrument to assess the root causes of stress and ill performance at the workplace level must assimilate the following concepts:

- A. Indicators for the presence of the risks;
- B. Control opportunities to cope with job demands, dysfunctional internal labour relations, as well as employment relations, and work-life imbalances;
- C. Cultural obstacles to the effective use of the control opportunities.

These concepts and relations are put together in the figure below.

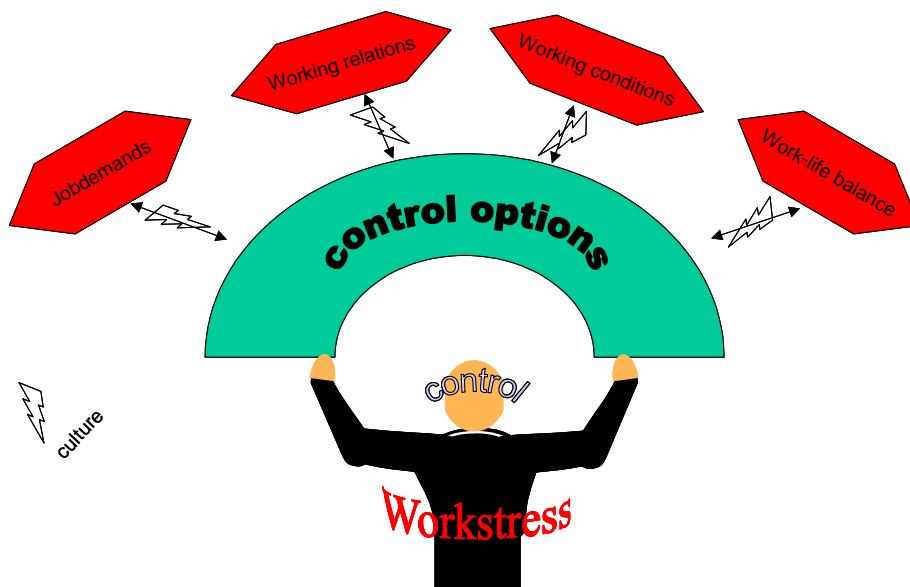


Figure 1: The TNO work-related stress model

The Tripod Sigma Model

With the aid of Tripod Sigma, those elements are searched for, within the way in which the employing organization is set up and managed, that increase the risk of occurrence of any of the above stressors. A number of distinct areas, termed General Failure Types (GFTs) are studied.

Tripod Delta, the questionnaire to detect safety risks, has eleven GFTs. These GFTs are those organization and management aspects which have frequently been found to constitute the underlying causes of incidents and accidents. Six of these General Failure Types also seemed to be possible sources of stress and poor performance. This expectation is based on theoretical considerations concerning the development within organizations of problems that may lead to stress, i.e. those problems that give people the feeling that they can no longer cope.

The six stress-relevant GFTs have been further elaborated and adapted for the purposes of Tripod Sigma. They are:

- procedures,
- materials and resources,
- organization,
- communication,
- training and skills,
- incompatible goals.

If all or part of an organization ‘scores poorly’ in any of these areas, problems may arise in that

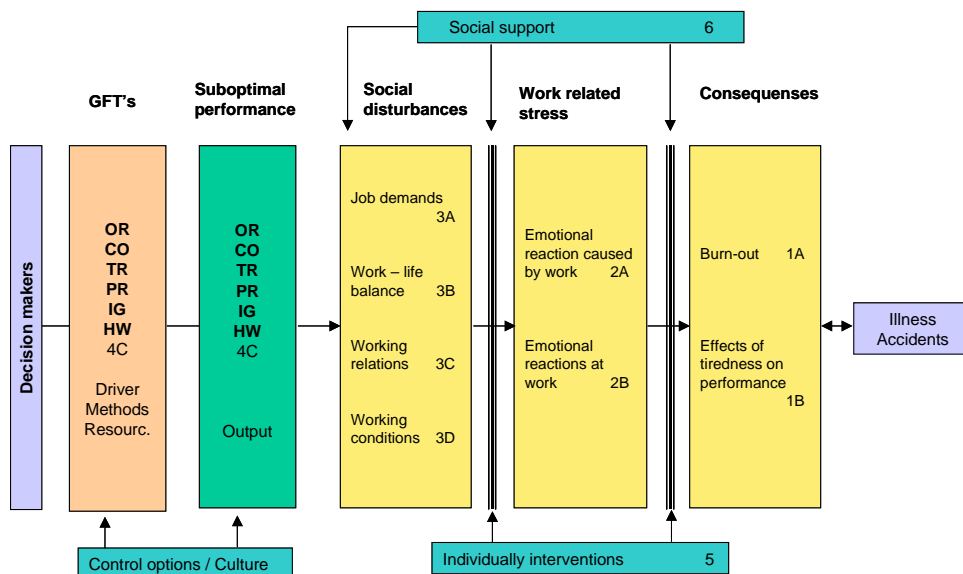
area or those areas that lead to work overload, work/life unbalance, upset working relationships and/or dissatisfaction with terms of employment.

Tripod Sigma not only assesses the ‘problems’ (output) in each area (GFTs) but also the possible causes of those problems, studying whether resources are adequate and methods are supportive. It is also investigated whether staff have sufficient ‘control options’ to resolve problems by themselves or with other people, and whether the organizational culture supports the use of such control options.

The allocation of resources and the practicalities of the methods ensue from policy choices made on (senior) management level. It is within these policy choices that the underlying causes of problems – but also the first steps towards resolving them – often lie. In each area, these ‘drivers’ are mapped out as far as possible, as the key to resolving problems lies in analysing them.

Several mechanisms may delay the progression from problems to stress and from stress to burnout. A very important one is ‘support by colleagues and supervisors’. These mechanisms have likewise been studied. In addition, the steps leading from work stress to burnout have been assessed: fatigue at and with work, and the deterioration in productivity that this causes.

Figure 2: Tripod Sigma Instrument: (OR: Organization, CO: Communication, TR: Training and competence development, PR: Procedures, IG: Incompatible Goals, HW: Hardware)



From risk to stressor

Procedures

If people are not able to fully execute all procedures without being pressed for time, or if people experience delays in their work because there are no procedures for certain situations, procedures increase the time pressure for people. If procedures are (unnecessary) complicated or time-consuming they increase the workload of people. In all these cases situations occur where procedures increase the workload or job demands of people.

Hardware

Problems with hardware, i.e. malfunctioning of hardware or the available hardware is no longer fit for the job, causes delays in the work. In this case hardware can increase the time pressure for people. Software (computer programs) can also increase the workload for people, for example if they have to use time-consuming computer programs for relatively simple tasks.

Communication

People need different kinds of information to be able to do their work: information as used by people to perform an assignment (for instance, input from another department to sell a product), information about what is expected from them (and when) and feedback on their performance, and information on the broader picture such as team and company targets. If people do not have the information they need for their work they make mistakes or experience delays. This is also the case if the information people receive is incorrect or unclear.

Organisation of work

If work is not efficiently organized this can cause coordination problems. Poor coordination can lead to delays in work. It can also lead to unnecessary work, for example because people work on a particular task only to find out later that a colleague was working on the same thing. Coordination problems can cause mistakes, and assignments people had not anticipated. It results in an increase of the workload and sometimes directly in working overtime.

Training and skills

If people in a department do not have the right skills or receive the right training to do their jobs,

there is a great risk of mistakes. The chances are that work will have to be redone. This increases the workload. Confidence in the competence of colleagues and supervisors is also a factor that can improve the working atmosphere within a team.

Incompatible goals

At all levels in the organization goals are set, and it sometimes happens that these goals are not compatible with one another. This can cause conflicts and stress. The risk of stress becomes significant when the goals of 'efficiency & productivity' are considered incompatible with the 'well-being' of employees.

In a situation of scarcity, where people with conflicting interests are dependent on each other (for something as important as their own financial reward for example), the possibility of conflicts is practically built in. In this situation the risk of upset working relations and conflicts occurs.

Methods

Samples

Data were collected in two pilot Organization, both part of the Shell company. The Tripod Sigma questionnaire was filled out by 712 respondents. Of these respondents 165 work in a virtual team. In addition to the questionnaire 18 interviews were held, with managers and HR officers. The purpose of these interviews was to validate the survey instrument by using another instrument (interviews) to measure the same items. The interviews were structured on the basis of the Tripod Sigma questionnaire in such a way that all the relevant topics from which scales can be constructed were discussed. This structure has made it possible to highlight the most important causes of work-related stress and to get the opinions of managers who have a broad overview of the types of work within their respective lines of business. Some of the interviews held after the survey results were analysed. These interviews were used to discuss the results and the steps that ought to be taken by management.

Missing value substitution

To save time and improve the response rate, for the second pilot it was decided to reduce the number of items that had to be filled out by each respondent to 150. Nevertheless, data had to be collected on all of the planned items, so each

respondent was presented with only part of the entire questionnaire. The planned missing values that naturally occur using this procedure have been estimated and substituted with an advanced statistical method (Graham et al., 1996).

In the current research project, every respondent was asked to answer only half of all the possible questions (apart from several invariant questions regarding personal characteristics and virtual work). To that end, the questionnaire was split into six parts, and by combining three differing subsets of those parts in several ways, six different questionnaire versions were created. As recommended by Graham et al. (1996), scale items were split across the different parts of the questionnaire. Each of the versions was submitted to each of six equally sized and randomly created subgroups. In combining the parts of the questionnaire into new versions, it was ensured that each of the parts was combined with each of the other five parts at least once, and that each version of the questionnaire was combined with each of the other five versions on at least one of the parts. In that way, the overlaps between parts and between versions were optimised.

The planned missing values (as well as the regular incidental missing values) were estimated and substituted based on the valid data using multiple imputation with the expectation maximization algorithm (Little & Rubin, 1989). This advanced algorithm is particularly better than (unconditional) mean substitution procedures (Graham et al., 1996). The main problem of (unconditional) mean substitution is that the variance of the involved variables becomes artificially small and the accuracy therefore artificially high. Multiple imputation with the expectation maximization algorithm is more adequate because it not only reproduces the mean μ as (unconditional) mean substitution also does μ but also the variance. This is accomplished by admitting an element of chance during estimation, albeit according to a set protocol. Additionally, the algorithm attempts to reproduce the covariance (or correlation) among variables. When estimating a missing value for a person on a specific item, this method will in practice use the answers of that person on all of the other items, as well as all of the answering patterns of all of the other respondents. In this project, multiple imputation with the expectation maximization algorithm was conducted

with the program 'PRELIS' (Jöreskog & Sörbom, 1996). In that process, not only the data of 443 respondents from the second pilot project were involved, but also the data of 269 respondents from the first pilot project. Using those extra respondents increases the reliability of the missing value estimation and substitution, particularly as the respondents of the first pilot project were each presented with the entire set of items. Variables measured at a nominal scale, however, were excluded from this procedure.

Measurements

Table 1 presents an overview of several subscales that were measured, their corresponding number of items and reliability coefficient. The answering categories on all scales were 'yes and no'. They were recoded in 0 (wrong, i.e. the 'negative' answer to the question) and 1 (right, i.e. the 'positive answer to the question'). So the higher the score on a scale, the better. A low score indicates the presence of the risk, measured with the scale. The same applies to the four stressors: the higher the score, the better. A low score on the stressors means that a large number of people experience high job demands, disbalance between work and private life, deranged working relation and dissatisfaction with working conditions.

Table 1 reliability of scales

Scale	Number of items	Answer categories	Crombachs α
Procedures	19	1-2	0.75
Hardware	15	1-2	0.71
Communication	22	1-2	0.82
Organisation	14	1-2	0.76
Training	15	1-2	0.72
Incompatible goals	17	1-2	0.67
Social support	10	1-2	0.83
High Job Demands	5	1-2	0.71
Work life balance	5	1-2	0.85
Deranged working relations	6	1-2	0.41
Working conditions	11	1-2	0.55
Burnout	7	1-2	0.72

The reliability analysis on the used variables pointed out that, except for the scales Working relations and Working conditions, each construct has sufficient reliability ranging from 0.67 to 0.85.

Especially the scales Deranged working relations and Working conditions can be regarded as a priori scales, meaning that they are constructed

based on a wider variety of topics with also more extreme questions. The scale Deranged working conditions for instance contains not only questions regarding the general atmosphere at work but also questions about sexual harassment and whether or not personal belongings have been stolen. The scale working conditions contains not only questions concerning pay and job security but also questions about career perspective and the value of ones knowledge and skills. A lower Crombachs alpha is a logical result of this.

The other GFT's have, especially at driver level, also elements of a priori scales in them. The driver questions represent the wide variety of management actions that can be taken to solve problems with respect to the specific GFT. Despite this element of a priori scales in every GFT those scales are sufficient reliable.

Validation

Before the questionnaire was sent out, interviews were held with 18 HR managers. In these interviews, possible work-related stress problems and all the relevant topics from which scales can be constructed, were discussed. Afterwards the results of the questionnaire were compared to the results of the interviews. In both pilot Organization, the picture that could be drawn from the interviews about the most significant problems in the pilot Organization and the most important risk factors that causes these problems, was confirmed by the analyses of the questionnaire.

Anchor modules

The assumption that the seven GFTs have a genuine bearing on stress risks and stress complaints must of course be verified. For that purpose, an existing reliable and valid TNO tool was largely incorporated in the test version of the tool applied at the pilot studies. This is NOVA WEBA, a tool for identifying stress risks in groups, with a reference database of 11,311 respondents built up in the course of research. The following modules of this tool were adopted: work demands (pressure of work), autonomy, contacts, organizational tasks, information provision and burnout. Items from the 'control problems' module were also taken over. During the pilot study, the NOVA WEBA modules have served as an 'anchor' for determining whether or not stress risks are involved.

Methods used for consultancy

Because this 'new' tool includes a large number of reliable and validated questions and modules from Tripod Delta and NOVA WEBA, it was possible to draw conclusions from the findings of the tool utilized in the pilot studies. The conclusions are therefore judgemental statements as to how 'favourable' or 'unfavourable' the scores are.

For the Tripod Delta questions and modules (in the light of previous research by Leiden University), the conclusion 'favourable' was arrived at if more than 90 per cent of respondents gave the desired response. The conclusion is 'unfavourable' if fewer than 70 per cent gave the desired response.² In the second pilot study the data obtained from the first pilot study were also taken as reference.

In NOVA WEBA, the conclusion is based on favourable or unfavourable deviations from the mean of the reference database. In addition, supplementary studies have shown that an unfavourable score on the NOVA WEBA scales is indicative of adverse impacts (in due course) for employee and organization alike.

For some of the scales, there is no reference file and no scoring rule either. This applies, for instance, to three of the four stressors and to the 'work-induced emotional reactions' scale. In the second pilot study, for these scales, the results of the first pilot study have been taken as reference. On the basis of this comparison, it is not really possible to formulate statements about 'favourable' or 'unfavourable' scores. However, if a score of the second pilot organisation, significantly deviates in the negative direction from the equivalent of the first pilot study, this is a point for attention, if only because it shows that improvement is possible.

² This scoring rule has been validated for the Tripod Delta questions. In Tripod Sigma, however, not all the Delta questions per BRF have been included, and some new ones have been added. This scoring rule has not, of course, been validated for the new questions, but an initial check does indicate that the results of the 'old' and 'new' questions point in the same direction. The <70% and >90% rule has, therefore, been provisionally applied to the new questions as well.

Results

Results of the first raw analyses

Because the second pilot study is just recently finalized, we were only able to do some very raw analyses on the data. Our first interest was in the relationship between the General Failure Types, the stressors and the scale used for work-related stress (Burnout). Control Options, Culture, and Social Support were not yet entered in the analyses.

Amount of variance explained in relationships between the different GFT's and cause of job-related stress

In the model presented in figure 2, four stressors, i.e. causes of job related stress, have been defined: high job demands, work-life disbalance, deranged working relations and dissatisfaction with working conditions. Analysis show that amongst the GFT's, Incompatible goals and Organisation were two dominant factors in explaining variance of the four stressors. The results suggest that problems with Organisation (work that is not efficiently organized, coordination problems) and Incompatible goals ('conflicts that occur when different interest are not compatible') were caused by problems with Procedures (situations in which people are not able to fully execute all procedures without being pressed for time, or in which people experience delays in their work because there are no procedures for certain situations), Hardware (malfunctioning of hardware or hardware that is no longer fit for the job), Communication (people do not have the information they need to do their jobs) and Training (people do not have the right skills and training to do their job).

In order to obtain which GFT's explain differences in the four stressors, regression analyses were conducted. The results of these analyses are presented in tables 2 and 3.

Table 2 Determinants of Job demands, Work-life balance, Working relations and Working conditions (n=712)

GFT	Job demands	Work-life balance	Working relations	Working conditions
	Bèta	Bèta	Bèta	Bèta
Procedures	0.13 **	0.20 ***	0.01	0.02
Hardware	0.09	0.07	0.02	0.10 *
Communication	0.12 *	0.03	0.08	0.07
Training	0.03	0.08	0.31 ***	0.30 ***
Explained variance	10%	11%	14%	16%

* p < .05, ** p < .01, *** p < .001

This table shows that there is a direct relation between problems with 'Procedures', problems with 'Communication' and high Job Demands. The scale 'Procedures' also has a direct relation with Work-life disbalance. These results support the hypotheses that time consuming or unclear procedures and a lack of the right information to do your job increased the job demands and the time pressure people experience.

The hypothesis that lack of confidence in the skills of co-workers or supervisors can have a negative effect on the working relations within a department is supported by this analysis. The third stressor, working relations is strongly related to 'Training'. There is also a strong direct relation between problems with training and dissatisfaction with working conditions and problems with Hardware and dissatisfaction with Working conditions. This can be explained by the fact that training, but also hardware (especially computer equipment) are sometimes considered as rewards. The scale working conditions also contains items on the opportunity for people to develop skills and competences. Sufficient training opportunity provides for that.

Table 3: determinants of Job demands, Work-life balance, Working relations and Working conditions (n=712)

GFT	Job demands	Work-life balance	Working relations	Working conditions
	Bêta	Bêta	Bêta	Bêta
Organization	0.09 *	0.20 ***	0.27 ***	0.04
Incompatible goals	0.44 ***	0.31 ***	0.12 **	0.39 ***
Explained variance	25 %	21%	12%	17%

* p < .05, ** p < .01, *** p < .001

Table 3 shows that there is a very strong direct relation between Incompatible goals and Job Demands, Work-life balance and Working conditions and a strong relation between Incompatible goals and Working relations. Conflicts that occur when different interest are not compatible is not improving the efficiency of the processes in the organisation. This increases the job demands and the time constrains of the individual workers. It can also result in scarcity of staff and budget. Conflicts easily occur in a situation in which there is scarcity in staff and budget and in which people are dependent of each other. The results of the analysis supports these ideas. Part of goals to increase health and well-being of employees can be to supply sufficient opportunity for people to take special leaves (like parental leave) or to work part-time. Opportunities like that increases the possibility for people to balance between work and private life. The scale Incompatible goals also contains items referring to pay and conditions of employees. A low score on this scale means that pay and conditions are not adapted to the wishes of employees. The idea that this can lead to dissatisfaction with working conditions is supported by the analyses.

Organization is very strongly related to Work-life balance and Working relations. Organization is also related to Job demands. An inefficient organization of work and coordination problems were expected to result in extra work and therefore increase the job demands of people. These problems were expected to result in work that was not anticipated of. Work that has to be done in overtime. The results of the analyses support these ideas. Coordination problems can easily lead to conflicts. The relationship between 'Or-

ganization' and 'Deranged work relations' supports this idea.

Tripod Sigma is developed as an instrument to help organizations to get information about their stress problems and to give them a direction to effectively solve those problems. A very important precondition for this of course is the ability of this instrument to explain a significant amount of the variance in job related stress. The amount of job related stress is measured by the Burnout scale. A low score on this scale means a high amount of job related stress. Table 4 shows the explained variance of Burnout by full Tripod Sigma model.

Table 4: determinants of burn-out (n=712)

Variables	Burnout
	β
Work load	0.22 ***
Work life balance	0.18 ***
Disturbed working relations	0.23 ***
Working conditions	0.01
Procedures	0.10 **
Hardware	-0.01
Communication	0.06
Organisation	0.02
Training	0.01
Incompatible goals	0.08
Explained variance	42%

* p < .05, ** p < .01, *** p < .001

The results show that there is a direct relation between Procedures and Burnout. This result is somewhat unexpected and will be discussed in the next section. Research has shown that there are four main categories of problems that can cause work related stress: high job demands, a disbalance between work and private life, deranged work relations and dissatisfaction with working conditions. The results of the analyses support three of the four expected relations. There is also a strong direct relation between Disturbed working relations, Work life balance and Job demands and Burnout. The hypotheses that dissatisfaction with working conditions can also increase work related stress is not supported. The full Tripod Sigma model explains 42% of the total variance of Burnout which is very high compared to other models.

Results of the consultancy project: Usefulness of the tool 'Tripod Sigma'.

An important test of the Tripod Sigma instrument is whether or not the results led to actions taken by management to improve the organisation.

In both pilots results of the questionnaire are presented, using the scorings rules described above. First the results of the 'output variables and stressors were presented. By means of the questionnaire, organizational factors have been identified that may increase the risks of these four stressors. These results were described in terms of the General Failure types.

The results of Tripod Sigma show whether or not a company has a problem with job related stress and which stressors are responsible for this. Furthermore the results show which element(s) of the organization should be improved in order to efficiently tackle problems in these area's.

The first pilot study showed that the fact that this instrument translates complex concept as work-related stress, by introducing the GFT's, to manageable issues is proved to be very useful. Besides the fact that the problems were translated to issues management could easily relate to, and the fact that issues were translated to drivers made it easy for management to see what action would be most successful to optimise the organisation. Introducing concrete control options and also cultural values, gave the participants a much broader view on how problems could be solved and what preconditions should be met to be successful in doing so.

Almost without support from extern consultants, group discussions between managers and employees based on the results of the pilot study, led to several actions to improve the organisation. On a higher level three elements became the centre of attention: Optimising the use of procedures, optimising the work life balance and diminishing the bureaucracy in the organization. The results were so promising that Tripod Sigma will be used in future investigations.

In the second pilot organization the briefing of the results to management and employees has yet to take place. Therefore no concrete improvements due tot the use of Tripod Sigma can be mentioned here. But the first reactions of the management of the pilot organizations were

promising. In preparation of the presentation of the results to senior management, a list of actions to be taken is already derived from the results of the analyses.

Discussion

In this paper the project of the development of the TRIPOD sigma instrument is described. The aim of this project was to develop an instrument for analysis of risks for work related stress 'all the way back' to the level of management decisions. This instrument should not only identifies risks, but also provides direct tools to reduce or prevent risks. Above all, this instrument should be a tool for management. As is described above in the section results of the consultancy project, as a management tool, Tripod Sigma proved its usefulness. Analyses of the questionnaire provided management with concrete advices on the steps that could be taken to reduce or prevent risks.

Tripod Sigma assesses the 'problems' (*output*) in six area's (GFTs) that can cause risks of work-related stress. Not only assesses Tripod Sigma problems, also the possible causes of those problems, are studied. Examined is whether *resources* are adequate and *methods* are supportive.

The allocation of resources and the practicalities of the methods ensue from policy choices made on (senior) management level. It is within these policy choices that the underlying causes of problems – but also the first steps towards resolving them – often lie. In each area, these '*drivers*' are mapped out as far as possible, as the key to resolving problems lies in analysing them.

The management actions needed to reduce or prevent risks were derived from the drivers of each area. The driver subscales contains of policy choices that underlie causes of problems on the six specific areas. For consultancy purposes it is important to incorporate a variety of significant policy choices in the model. By doing this, a priori (sub)scales are created. Although the Crombachs Alpha of most of the driver subscales was reasonable ($> .60$), they were lower than the Crombachs Alpha of the rest of the scales. The question is if it is possible and desirable to develop scales of these items. Using these items as detached items with all its own relevance could

also be an option. This option will be examined in further analyses.

The fact that six very specific areas were distinguished, made it possible to make the actions needed to reduce or prevent risks, concrete and workable. The results of the regression analyses, however show that a substantial part of the variance in the four stressors is explained by two of the six General Failure Types, namely Organisation of Work and Incompatible Goals. High job demands, imbalance between work and private, deranged work-relations and dissatisfaction with working conditions can be explained for a large part by work not being efficiently organized and by the fact that conflicts occur when different interest are not compatible. The results suggest that problems with Organisation of Work and Incompatible Goals were caused by problems with Procedures, Hardware, Communication and Training. So the situation in which people are 1) not able to fully execute all procedures without being pressed for time, or if people experience delays in their work because there are no procedures for certain situations, and 2) in which people experience problems with hardware, 3) in which people do not have the information they need to be able to do their work and 4) in which people were not skilled enough to do their work, causes coordination problems and result in the perception of incompatibility of goals of efficiency & productivity on the one hand and health & well-being of employees on the other hand. It may even be the case that problems in the General Failure types 'Procedures, Hardware, Communication and Training, are summarized in Problems with the Organisation of Work and problems with Incompatible Goals.

For research purposes it might be enough to only use two of the six General Failure Types. For consultancy purposes however it is very useful to analyse all six of the areas.

There is a high correlation found between the six General Failure Types (the lowest correlation is .37). This can be explained by the fact that, although the six scale cover specific areas, the structure of the scales is the same. For every area questions are asked about 'resources', 'methods' and 'problems' in terms of delays, extra work, conflicts etc. The fact that there is also a high correlation between the subscales 'drivers', the

subscales 'methods' and 'resources' and the subscales 'output' support this explanation.

The results show that there is a direct relation between Procedures and Burnout. This result is somewhat unexpected. For some parts of the pilot Organization following procedures is literally a matter of life and death (or accidents). An unclear or missing procedure, not only increased job demands, but in this situation, may cause strain on its own. Another explanation can be that good procedures also decreases ambiguity for people and provide them with a clear direction of what to do in a variety of circumstances. Ambiguity and uncertainty can cause feelings of stress. Effective procedures may prevent this.

The hypotheses that dissatisfaction with working conditions can also increase work related stress is not supported by the results of the regression analyses. Three explanations can be given for this result. Dissatisfaction with working conditions may have a negative effect on the way people feel about their work, but not necessarily have an effect on the strain people experience. Dissatisfaction with working conditions may have a stronger effect on well-being and overall satisfaction than on the work-related stress people experience. As overall job satisfaction is also measured in this project this will be examined in further analyses. Another explanations could be the fact that this scale is an a priori scale, with a low Crombachs alpha, and that this effected the results. A selection effect can be the third explanation. Most people at Shell are satisfied with their working conditions, there is not much variance in the scores on this scale.

Conclusion

In this paper the first results of the construction of the Tripod Sigma instrument are presented. The focus of this paper is on two issues: is the instrument valid and reliable and does the use of this instrument play an important role in optimising the organisation.

The results so far show that the instrument is valid and reliable. The results from the interviews that were held before the instrument was used were later on confirmed by the results from the survey measurements. Also the results from

the anchor modules matched the data from Tripod Sigma modules.

The total instrument proved to be successful in explaining a substantial part of the variance of strain of individuals (measured with a scale called 'Burnout'). The hypothesis that the GFT's caused the problems on the four Job stressors was largely supported. This too applies for the hypothesis that the four stressors cause strain on the level of individuals. The fact that Procedures on itself contributed to the explanation of the variance of Burn out will be subject of further analysis.

Due to the use of Tripod Sigma a complex construct as Job related stress was translated to various concrete organizational problems that management and employees could relate to. This helped the management in optimising the organization. Because of the translation of Job related stress into day to day problems, the results became a start in discussion between management and employees and has already led to various improvements of the organization. The fact that the instrument goes back into the causation chain all the way to the management decisions that allowed these risks to occur, made clear the steps management could take to decrease these risks. The first pilot organization has the intention of using this instrument in the future, this also supports the usefulness of the tool.

There are still a few questions that need to be answered. The specific role of the various control options had yet to be analysed. Also the exact influence of the cultural values on the effectiveness of control options will be subject of future research. Furthermore effort will be put in reducing the number of questions without losing the psychometric qualities of the instrument.

References

- Cox, T., Griffiths, A., Rial-González, E., (2000). Research on work-related stress. European Agency for Safety and Health at work
- Groenweg J. Controlling the controllable, the management of Safety, 4th revised edition, DWSO Press, Leiden University, 1998.
- Graham, J.W., Hofer, S.M. & MacKinnon, D.P. (1996). Maximizing the usefulness of data obtained with planned missing value patterns: An application of maximum likelihood procedures. *Multivariate Behavioral Research*, 31, 197-218.
- Houtman I., Otten F. & Venema A. (2001) Kerncijfers, Arbeid gezondheid en sociale zekerheid in: Houtman I., Smulders P. & Klein H. J. (red.) Trends in Arbeid, Kluwer, Alphen ad Rijn.
- Jöreskog, K.G. & Sörbom, D. (1996). PRELIS 2: User's reference guide: A program for multivariate data screening and data summarization. A pre-processor for LISREL. Chicago: Scientific Software International, Inc.
- Klein Hesselink D.J., Klink J. van der, Vaas S., Houtveen J.H., Frielink S.J. (2001) Stand der wetenschap: werkdruk. Een inventarisatie van maatregelen om werkdruk en werkstress te voorkomen of terug te dringen. Opdracht: SZW, in press.
- Little, R.J.A. & Rubin, D.B. (1989). The analysis of social science data with missing values. *Sociological Methods and Research*, 18, 292-326.
- Projectgroep WEBA (1989), Functieverbetering en organisatie van de arbeid. Den Haag: Ministerie van SZW (S71).
- Vaas S, Dhondt S., Peeters MHH, Middendorp J. (1995). De WEBA-methode: deel 1, WEBA-analyse en handleiding, Alphen aan den Rijn/Zavetem, Samsom, Bedrijfsinformatie.
- Vaas S, Klein Hesselink DJ, Berg SA van den, Peeters MMH. Interventies bij Werkdruk. (1999) TNO Arbeid.
- Veerman T.J., Schoemaker C.G., Cuelenaere B., Bijl R.V. Psychische arbeidsongeschiktheid. Een overzicht van actuele feiten en cijfers. Bureau Astri/ Trimbos Instituut, juni 2000.
- Veldhoven, M. van, Jonge J. de, Broersen S., Kompier M., Meijman T., (2002). Specific relationships between psychosocial job conditions and job-related stress: A three-level analytic approach. *Work & Stress*, 16, 207-228.