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Work-related stress risk assessment: a critical review based on psychometric principles of an objective tool

Isabella Corradini⁽¹⁾, Assunta Marano⁽¹⁾, Enrico Nardelli⁽²⁾

(1) Themis Research Centre, Roma, Italia, {isabellacorradini, assuntamarano}@themiscrime.com

(2) Department of Mathematics, University of Roma "Tor Vergata", Italia, nardelli@mat.uniroma2.it

Abstract: Many approaches to work-related stress risk assessment suggest the integration between a phase where objective data are collected and analysed, and a phase where results of data collection and analysis are discussed and compared with information coming from the workers. On the other side, the use of self-report job stress measures has been criticized, due to their potential distortions, and stress researchers have repeatedly called for an approach based on the use of objective measures. The Italian law for work-related stress risk assessment, closer to the latter approach, prescribes a two-stage procedure: first a set of objective measures and then, conditionally to the outcome of the first stage, a set of subjective measures. We therefore describe and critically review, on the basis of psychometric principles, the tool used for the objective stage in the most adopted method in Italy. Such a tool is a checklist for which we discuss a number of issues suggesting it is not methodologically well founded. We conclude these weaknesses affect the practice of work-related stress risk assessment.

Keywords: work-related stress risk assessment, psychometric properties, rating scales and checklists, objective measurements

1. Introduction

Work-related stress is one of the most widespread occupational illnesses. Hoel, Sparks, & Cooper (2001, pp.45-46) report that stress accounts for up to 30% of all work-related illness annually, on the basis of a number of reliable studies based on large population samples from the US, Europe and Australia.

A number of studies have found that the costs of occupational illness in general, and in particular of work related stress, are not negligible.

The European Agency for Safety and Health at Work (EU-OSHA, 1999) surveyed the costs (both in absolute value and in percentage of the Gross National Product) of occupational illness in EU-15. Computing the total in euros gives a value between 185 and 289 billion euros a year.

The European Commission (2000, p.13) conservatively estimated the cost of work-related stress in 20 billion euros a year for the EU-15.

A report on work-related stress of the European Foundation for the Improvement of Living and Working Conditions (2007, p.25) analysed costs of work-related stress for The Netherlands and Germany.

More recently, the EU Executive Agency for Health and Consumer (2013, p.31) estimated that 14% of employed individuals who suffer from stress will go on to develop depression and the total costs of depression in the EU-27 is 617 billion euros.

EU-OSHA (2014, pp.7–11) provides estimates for socio-economic costs in a number of European and non-European countries. Its conclusions (p.23) state "*there is evidence suggesting that appropriately planned and implemented workplace interventions focusing on preventing stress, improving psychosocial work environment and promoting mental health are cost effective.*"

Hence, the need of an approach able to evaluate, prevent and mitigate stress and psychosocial risks at work is strong.

Stavroula & Aditya (2010, p.11), in a report prepared for the World Health Organization, have suggested that the most accurate assessments of work-related stress consists in the integration and correlation among objective measures of working conditions (observational measures) and information coming from workers (e.g., self-report questionnaires). The difficult balance between subjective and objective evaluation is indeed the most delicate point in the assessment of work-related stress.

As discussed by Ostry, Kelly, Demers, Mustard, & Hertzman (2003) on the basis of (Chen, Spector, & Jex, 1995; Spector, Dwyer, & Jex, 1988; Spector & Jex, 1991) "*some researchers have argued that any associations observed between self-reports of psychosocial work conditions and health outcomes may be confounded by the subjective 'state' or personality of the worker*", and also "*According to this perspective, the major factor responsible for this confounding is 'negative affectivity' and that the impact of this confounding is so great that self-reports of job work conditions are essentially a measure of negative affectivity*".

2. Background

The normative background in Italy for work health and safety is the Legislative Decree 81/2008 (Ministry of Labour, 2008), which has transposed into the Italian law the Framework Directive of EU-OSHA (1989). Its article 28, paragraph 1, states the obligation for all public and private employers to assess, *inter alia*, work-related stress of their workers according to the content of the European Framework Agreement on Work-Related Stress (2004). This agreement does not provide an exhaustive list of potential stress indicators but describes the necessity of analysing both objective and subjective factors. The need for such an integrated approach is founded on a number of studies such as, for example, Frese & Zapf (1988) and Hurrell, Nelsons, & Simmons (1998).

Paragraph 1bis of the above cited Legislative Decree states also that such an assessment has to be made in respect of the guidelines in (Permanent Consultative Committee of the Ministry of Labour for Workplace Health and Safety, 2010). These guidelines describe a methodological approach aiming at providing the "*minimum level of implementation*" for employers to comply with the legislative duties for work-related stress risk assessment.

The approach defines an evaluation method organized in two sequential phases. The first one (defined "preliminary assessment") is mandatory, while the second one (defined "in-depth assessment") is required only if both the preliminary assessment has revealed risk elements requiring mitigation and the adopted mitigating actions have proven ineffective.

The preliminary assessment phase requires collecting only objective factors, as long as they belong to at least three categories: sentinel events, work content, and work context. Such a collection may be carried out by means of checklists compiled by the health and safety representatives.

The in-depth assessment phase allows for the use – on homogenous groups of workers – of tools such as self-report questionnaires, focus groups, semi-structured interviews, again investigating at least the same three above cited categories.

The prescription of such a staged assessment implicitly defines a hierarchical subordination of subjective measures to objective ones. According to the (Inter-Regional Technical Coordination Committee of Prevention in Workplaces, 2012, p.27) the consequence is that if the first stage reveals a low level of risk the assessment process terminates without carrying out the second stage (see question G.1). This situation is a clear departure from what the European Framework Agreement on Work-Related Stress (2004) prescribes and from what is reported in the literature (Frese & Zapf, 1988; Hurrell, Nelsons, & Simmons, 1998; Stavroula & Aditya, 2010). Regarding this Italian approach Zoni and Lucchini (2012, pp.47-48) have already recognised that "*A limitation of this approach is represented by the predominant relevance given to the assessment of objective*

factors in the first steps of the evaluation", which appears to be motivated by the repeated calls for objective measures overcoming the limitations of self-perception based measures, as discussed, for example, by Hurrell, Nelsons, & Simmons (1998).

From what above discussed it is clear that a correct and reliable execution of the preliminary assessment phase is absolutely important in the Italian context. A failure at detecting a risk situation in this phase would in fact make it completely impossible to reveal risky situations. A recent survey on the stress level in Italian workers (Italian Institute for Political, Social and Economic Studies, 2014), has found that stress affects *often* or *always* more than 30% of workers. This is not far from the value found in a 2005 survey by EU-OSHA (2009, foreword), declaring work-related stress affects 22% of workers of the EU-27.

Note that the guidelines of the Permanent Consultative Committee described the need for surveying the results of the application of its indications two years after their entering into force. As of today we are not aware of any publication reporting these results. Instead, some critical voices have been raised in Italy against these guidelines. For example Curzi, Fabbri, & Nardella (2013, p.1) states the guidelines have "*diagnosis capability ... faulty due to their incoherence with respect to the European Framework Agreement on Work-Related Stress*" and a "*preventive potential ... inadequate in terms of identification of corrective measures of organizational nature*". Also, Galli, Mencarelli, & Calzolari (2013, pp.2-3) discuss these guidelines stating that the Italian Union of Labour (UIL) is "*strongly critical, particularly with respect to the under-evaluation of workers' role and to the optional role of the assessment of workers' perception, evaluating the proposed methodology incoherent both with respect to the European Framework Agreement on Work-Related Stress and to the most elementary principles of relevant national and international literature*".

3. Description

The most used methods in Italy for the work-related stress risk assessment (Guglielmi, Depolo, & Violante, 2013, p.78) is the one designed by the National Institute for Insurance against Accidents at Work (INAIL), a public non-profit entity safeguarding workers against physical injuries and occupational diseases. The description of INAIL method is contained in (INAIL, 2011), a user manual for Italian companies to comply with the obligations deriving from the above cited Legislative Decree 81/2008. An English translation is available on their site (INAIL, 2013).

The INAIL method defines itself (INAIL, 2013, preface and introduction) as "*based on the Management Standards model of the Health and Safety Executive (HSE)*" and proposes a

checklist for the preliminary assessment phase and an indicator tool consisting in a 35-item questionnaire for the in-depth assessment one, in accordance with the Italian methodological approach above described. The INAIL questionnaire is a translation to Italian of the HSE Management Standards Indicator Tool (HSE, 2004) while for the INAIL checklist there is no indication of how it is related to the HSE Management Standards model.

It is worthwhile to remember that the HSE approach to stress develops the idea of standards for managing work-related stress in terms of organizational states to be achieved and discusses how their achievement can be assessed by workers (Cousins, Mackay, Clarke, C. Kelly, P.J. Kelly, & McCaig, 2004; Mackay, Cousins, Kelly, Lee & McCaig, 2004).

Moreover, HSE emphasizes in its approach the involvement and the perception of workers, highlighting the need of discussing with them by means of focus groups the outcome of data collection. It underlines that issues revealed from the data collection phase may not turn out to be the most important ones for workers and, on the other side, new (and possibly more important) issues can emerge in focus groups that have not been revealed by the data collection phase.

In the INAIL method the data collected during the preliminary assessment phase by means of the checklist are not subject to a focus group discussion but just to a consultation with health and safety representatives.

The INAIL checklist is structured in 3 areas:

1. *sentinel events*, collecting the trends of 10 indicators in the sub-areas of injury percentage, sick leaves, staff absence percentage, untaken leaves percentage, internal turnover percentage, external turnover percentage, disciplinary sanctions, unplanned health examinations, formal complaints, judicial claims filed for downgrade/ dismissal/ harassment;
2. *work content*, analysing 36 items in the 4 sub-areas of work environment, task planning, work load, and working hours;
3. *work context*, analysing 30 items in the 6 sub-areas of organizational culture, role in the organization, career development, autonomy and control, inter-personal relationships, home-work interface.

In the following we first analyse how data are collected and a risk level is computed for each area of the checklist and then how the results of these data collection and risk evaluation are combined to produce the final outcome of the preliminary assessment phase.

A methodological choice, common to all areas and to the construction of the final outcome, is that data collected result in a *score* and the risk level is computed depending on the ratio of the

obtained score to the maximum attainable one. If the obtained ratio is less than or equal to 25% there is a "low" ("non relevant" in the Italian version, this term is used in the following text) risk level, if higher than 25% and less than or equal to 50% a "medium" risk level, otherwise a "high" risk level (see headers of coloured columns in figures 1, 2, and 3, extracted from INAIL, 2013).

3.1. Sentinel events

For each sentinel event but the last two ones, it is observed whether the value of indicator decreased, remained stable, or increased, and a corresponding score of 0, 1, 4 is noted down. The absence or presence of events of the last two categories directly produces a score of 0 or 4, respectively. Decrease, stability, or increase have to be computed with respect to the average of the previous 3 years. For the indicators expressed in percentage the method prescribes to compare the last year value, while for indicators expressed in absolute value no specification is given.

The score of the area is eventually obtained by means of the following conversion process (Figure 1):

- $0 \leq \text{sum of scores} \leq 10$ results in a non-relevant risk level and an area score of 0
- $11 \leq \text{sum of scores} \leq 20$ results in a medium risk level and an area score of 2
- $21 \leq \text{sum of scores} \leq 40$ results in a high risk level and an area score of 5.

I - SENTINEL EVENTS							
INDICATOR	TOTAL SCORE FOR EACH INDICATOR	LOW 0-25%		MEDIUM 25-50%		HIGH 50-100%	
		FROM	TO	FROM	TO	FROM	TO
ORGANIZATIONAL INDICATORS		0	10	11	20	21	40
TOTAL SCORE		0		2		5	

Figure 1: Scores and risk levels for area 1 (sentinel events)

3.2. Work content

Each of the 36 items is investigated through a yes/no question producing a score of 0 or 1.

The score of the area is exactly equal to the sum of scores and results in the following risk levels (Figure 2):

- $0 \leq \text{area score} \leq 13$: non-relevant risk level
- $14 \leq \text{area score} \leq 25$: medium risk level
- $26 \leq \text{area score} \leq 36$: high risk level

Note that for this area it is not respected the general partition rule, since the boundaries between risk levels are set at 13 and 25 instead of at 9 and 18.

Risk levels may be computed also for the four sub-areas. Also in this case the general partition rule is not respected.

II - WORK-CONTENT AREA							
INDICATOR	TOTAL SCORE FOR EACH INDICATOR	LOW 0-25%		MEDIUM 25-50%		HIGH 50-100%	
		FROM	TO	FROM	TO	FROM	TO
Work environment and equipments		0	5	6	9	10	13
Planning Task		0	2	3	4	5	6
Workload - work pattern		0	4	5	7	8	9
Working hours		0	2	3	5	6	8
TOTAL SCORE		0	13	14	25	26	36

Figure 2: Scores and risk levels for area 2 (work content)

3.3. Work context

Each of the 30 items is investigated through a yes/no question producing a score of 0 or 1. The area score is computed by first summing only the first 26 items. Next the sum of the 4 last ones is computed. If the latter sum is greater than 0 it is discarded and the former one is the area score. Otherwise 1 is subtracted from the former sum and the result is the area score. No motivation is given for treating these 4 last items (making the whole of the sub-area home-work interface) in a different way.

The area score results in risk levels according to the following (Figure 3):

- $0 \leq \text{area score} \leq 8$: non-relevant risk level
- $9 \leq \text{area score} \leq 17$: medium risk level
- $18 \leq \text{area score} \leq 26$: high risk level

Note that for this area is not respected the general partition rule, since the boundaries between risk levels are set at 8 and 17 instead of at 6 and 13.

Risk levels may be computed also for the first five of the six sub-areas. Also in this case the general partition rule is not respected.

III - WORK-CONTEXT AREA							
INDICATOR	TOTAL SCORE FOR EACH INDICATOR	LOW 0-25%		MEDIUM 25-50%		HIGH 50-100%	
		FROM	TO	FROM	TO	FROM	TO
Function and organizational culture		0	4	5	7	8	11
Role within the organization		0	1	2	3	4	
Career path		0	1	2		3	
Decisional making - work control		0	1	2	3	4	5
Interpersonal relationships at work		0	1	2		3	
Work-home interface - work-life reconciliation*							
TOTAL SCORE		0	8	9	17	18	26

(*) if the total score of the "Work-home interface" is 0, enter the value -1.
If it is more than 0, put a 0. Companies are ranked in the "risk level table" by the sum of scores of the three areas.

Figure 3: Scores and risk levels for area 3 (work context)

3.4. Construction of the overall outcome

The overall outcome is constructed by summing the 3 area scores. The result is interpreted as it follows (Figure 4, extracted from table at p.51 in INAIL, 2013):

- $0 \leq \text{sum of area scores} \leq 17$: non-relevant risk level
- $18 \leq \text{sum of area scores} \leq 34$: medium risk level
- $35 \leq \text{sum of area scores} \leq 67$: high risk level.

	FROM	TO	RISK LEVEL
	0	17	LOW 25%
	18	34	MEDIUM 50%
	35	67	HIGH over 50%

Figure 4: Scores and risk levels for the overall outcome

4. A critical review

In this section we discuss some of what we feel are critical methodological issues of the INAIL checklist with respect to its psychometric properties and to the quality of data organization and accessibility (Aiken, 1996; Kaplan & Saccuzzo, 2012; Nunnally, 1978).

Critical points common to the three investigated areas are:

- No justification is provided for converting the sum of scores to an area score for the first area (sentinel event) and not for the other two ones (work content and work context).
- No objective evidence of a correlation with the measured phenomena is provided for the choice of the thresholds adopted for dividing risk levels.
- All items have equal significance. E.g. the "*circulation of the organizational chart*" (question #37, INAIL, 2013, p.45) has the same weight for the final risk assessment as the "*management of illicit behaviour or abuse of power by colleagues or supervisors*" (#61, p.48).

One of the publicly available Risk Assessment Documents required to comply with Italian legislative requirements (City of Imola, 2013, p.24) explicitly says "*The empirical basis of the method used to compute and weigh scores assigned to items is **unknown***".

4.1. Sentinel events

The most relevant weakness is that increase or decrease is measured using absolute values and not as a percentage. Even for those indicators expressed in percent, depending on the magnitude of the base level a big difference may exist between an increase of 1 point and 5 points. Moreover, if there is an increase, a 100% increase should weigh more than a 1% increase.

Next, we note that little emphasis is given to the need of providing supporting documentation giving evidence to the revealed trends.

Finally, we observe that it would have been more appropriate to compare values of sentinel events also to reference values for the industrial sector.

4.2. Work content and work context

A critical element for both areas is that it is difficult to provide an "objective" answer to some questions, since they often investigate issues with a qualitative nature and their meaning depends from the subjective interpretation by the compilers. For example, expressions like "*adequacy of equipment resources to accomplish the task*" (question #15, INAIL, 2013, p.42), "*particularly monotonous works*" (#16, p.42), or "*roles are clearly defined*" (#49, p.46) are not objectively interpretable (Barattucci & Sarchielli, 2013).

Next, the yes/no questions are not able to properly detect elements of risk since the simple positive or negative answer does not give indications on the quality of investigated aspects. For example, a yes/no answer to a question like "*Meetings between management and employees*" (question #43, INAIL, 2013, p.45) does not allow evaluating conditions, frequency, and quality of the meetings, which are instead highly relevant aspects to be evaluated for the sub-area of organizational culture.

4.3. Construction of the overall outcome

In this sub-section we discuss four critical points in the construction of the overall outcome of the preliminary assessment. They are highly relevant in the light of the fact that the INAIL method is freely and widely available due to the institutional role of such an organization.

4.3.1. Area scores are summed

The most critical element of the INAIL method is that the summing of area scores tends to hide risk levels for some of the areas. Consider, for example, a situation where the area scores for the three areas are, respectively, 5 (high), 3 (non relevant), and 9 (medium). Then the overall risk score is 17 with an overall risk level of "non relevant". Note that the methodological guidelines in case of an

overall risk level of "non relevant" conclude that in such a case the checklist "*does not reveal specific conditions that can determine the presence of work-related stress*" (INAIL, 2013, p.51). Hence on the basis of the staged assessment prescribed by the Italian methodological approach (Section 2) there is no need of an in-depth assessment.

For such a delicate process, it would be more appropriate to observe the concurrence and concordance of results in the various areas than to simply compute their sum, which is well known has a smoothing effect on the overall result. The construction of a synthesis indicator should be done using the appropriate logical-mathematical combinations able to correct possible distortions of single area indicators (Lazarsfeld, 1966). The INAIL method leads to a contrary result: the synthesis indicator hides the outcome of single area indicators.

4.3.2 Prescriptions for medium/high overall risk levels are ambiguous

When discussing the overall assessment outcomes of "*medium*" and "*high*" the INAIL method advises that corrective actions have to be taken for those sub-areas of work content and work context "*with the highest risk level*" and, if ineffective, an in-depth evaluation has to be performed (INAIL, 2013, pp.24-25).

These prescriptions present some ambiguity. First of all it is not motivated why no intervention is prescribed in the area of sentinel events: it is true that these describe objective facts that cannot be altered, but at least it could have been suggested to investigate possible correlation/dependencies among them and the work content/context sub-areas with the highest risk levels. Next, it is not justified why corrective actions have to be taken only for the sub-areas with the "highest" risk level. Nor the prescription is formulated in an operational way: does it refer to the two highest or three highest or how many? Finally, the same corrective approach is suggested in the two cases of overall risk level of "medium" and "high": which is then the difference between the two situations?

It is also clear that since these prescriptions are given under the paragraphs describing the overall risk level of "medium" and "high" (INAIL, 2013, pp.24-25) nobody will apply them in the case of an overall risk level of "non relevant". The need of addressing the critical situations in those sub-areas will thus be neglected.

4.3.3 Adaptation of the checklist is not discussed

A third important critical element is that, since not all items in the checklist are applicable to all companies, it is not clear how the same checklist may be applied to any kind of company. Contrast this with what is said, for example, in (Satzler & Gerey, 2009) or in (Alis, Dumas, & Poilpot-Rocaboy, 2010, p.141). No guidance is provided in (INAIL, 2011; INAIL, 2013) for the adaptation of the checklist to the specific sector of an organization nor is any discussion provided on the

reliability of such a modification. For examples, do threshold values separating risk levels in various areas keep their validity independently of the organization's sector?

Moreover, methodological indications should be provided on how to manage the "not applicable" items: how these affect the area score and the overall result of the preliminary assessment? Nothing is said on this highly relevant problem in (INAIL, 2011; INAIL, 2013).

Finally, no normative database is provided for purpose of comparison and interpretation (Aiken, 1996; Kaplan & Saccuzzo, 2012; Nunnally, 1978).

4.3.4 The checklist is not validated

The fourth element of criticism is that INAIL declares (INAIL, 2013, preface) that its methodological path "*has been merged with the experiences of the*" Inter-Regional Technical Coordination Committee of Prevention in Workplaces (2012), containing guidelines for the correct risk management within companies and for oversight activities of Public Health agencies. These prescribe that checklists to be used for the preliminary assessment have to be

"scientifically valid with respect to:

- *evaluated stressors*
- *objective and verifiable elements examined to estimate stressors*
- *criteria to assign scores and compute risk level "* (p.18)

But no evidence is given in (INAIL, 2011; INAIL, 2013) of a scientific validation able to prove the INAIL checklist is a useful, valid, and reliable method (Aiken, 1996; Kaplan & Saccuzzo, 2012; Nunnally, 1978). It has just been reported (Ronchetti et al. 2014) that there should be a convergent validity between the checklist and the INAIL indicator tool. But the published details of the study are not enough to understand the reliability of these reported findings.

5. CONCLUSIONS

The most widely used European models for work-related stress evaluation emphasize an approach centred on workers' perception. But, given the widely discussed potential distortions of self-report perceptions, several attempts have been mounted to develop observational methods.

We have analysed, as an example of these attempts, an objective tool developed in Italy which declares itself to be inspired to the HSE approach. It was already observed in the literature that the INAIL checklist has departed from HSE's spirit, due to the "*predominant relevance given to the assessment of objective factors in the first steps of the evaluation*" (Zoni & Lucchini, 2012, pp.47-48). Indeed, the use of a checklist as a closed system of measurement and not as a process of evaluation shifts the balance of the assessment method towards objective measures.

We have found that the INAIL checklist has a number of methodological weaknesses in terms of psychometric principles, analysed and discussed in Sections 3 and 4. We therefore conclude it is not methodologically well founded. Given the fact that assessment outcomes have a sensible impact on workers' safety measures we conclude these weaknesses have a clear bearing on the practice of work-related stress risk assessment.

Given the relevant literature and the complexity of involved phenomena, we think it should be mandatory to evaluate work-related stress risk by means of the integrated use of both well founded objective measures and adequate workers' involvement, through focus groups, questionnaires, and similar tools, as suggested, among others, by (Albini, Zoni, Parrinello, Benedetti, & Lucchini, 2011; Panari, Guglielmi, Ricci, Tabanelli, & Violante, 2012).

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Short biographies of authors

Isabella Corradini (<https://www.linkedin.com/pub/isabella-corradini/51/287/a0b/en>) is a work and organizational psychologist with a specialization in forensic psychopathology and clinical criminology.

She is Scientific Director of the Themis Research Centre and Adjunct Professor of Social Psychology in the University of L'Aquila, where she also cooperates to international projects in social sciences within the Tempus Program.

She is expert of the psychosocial approach to workplace issues regarding safety (stress, technostress, mobbing, harassment, stalking) and security (crime prevention, profiling in physical security and cybercrime). She is expert of psychological issues in communication and a Court Expert for Psychology and Criminology. She is also a consultant and a trainer in these areas for leading Italian companies.

She has written many papers and books in the expertise areas and she is the editor of a book series in reputation with a major Italian publishing house (Franco Angeli).

Assunta Marano (http://dip38.psi.uniroma1.it/sites/default/files/cv/Marano_Assunta_CV.pdf) has a Ph.D. in Cognitive Psychology, Psychophysiology, and Personality, a post-graduate specialization in Assessment Psychology and Counseling, and an advanced post-graduate specialization in Statistical Methods for Biomedical Research and Practice.

She has been Adjunct Professor in Sapienza University of Rome and the University of Salerno, and is currently Adjunct Professor in Developmental Psychology at the University of L'Aquila.

She has been a research fellow analyzing IEA/ETS International Databases at the University of Roma Tre. She is currently responsible for methodology in a project on tablet use in learning disabilities for the Local Health Agency Roma B, responsible of methodology in a project on the evaluation of risk and protective factors for the prediction of academic and professional achievement at University of L'Aquila, and responsible of methodology in the Themis Research Centre.

She has several national and international publications (<http://www.hogrefe.it/catalogo/i-nostri-autori>) in the above areas and in the psychological testing and assessment area.

Enrico Nardelli is full professor of Informatics in the Department of Mathematics of the University of Roma Tor Vergata (<http://www.mat.uniroma2.it/~nardelli/>). He has more than 140 international refereed papers in the areas of algorithms and data structures, databases and geographical information systems, tools and environments for interaction with information systems, cooperative and distributed information systems, bio-informatics, and digital art.

He is Vice-President and member of the Executive Board of Informatics Europe, the association of informatics departments and research laboratories in Europe and neighbouring areas. He is member of the Executive Board of EQANIE, the European Quality Assurance Network for Informatics Education. He is Past-President and member of the Executive Board of GRIN, the Italian Association of University Professors of Informatics.