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Psychosocial risk management

Ana Fernandes[a], Margarida Figueiredo[b], Liliana Ávidos[c], Jorge Ribeiro[d], Dinis Vicente[e], José Neves[c,f], Henrique Vicente[a,f]*

[a]*Departamento de Química, Escola de Ciências e Tecnologia, REQUIMTE/LAQV, Universidade de Évora, Évora, Portugal*
[b]*Departamento de Química, Escola de Ciências e Tecnologia, CIEP, Universidade de Évora, Évora, Portugal*
[c]*Instituto Politécnico de Saúde do Norte, CESPU, Portugal*
[d]*Instituto Politécnico de Viana do Castelo, Rua da Escola Industrial e Comercial de Nun'Álvares, Viana do Castelo, Portugal*
[e]*Escola Superior de Tecnologia e Gestão de Leiria, Instituto Politécnico de Leiria, Leiria, Portugal*
[f]*Centro Algoritmi, Universidade do Minho, Braga, Portugal*

Abstract

A number of guidelines for *Psychosocial Risk Management* in organizations have been proposed in recent decades; however, some reviews on the subject also highlights that the terms *Stress* and *Psychosocial Risks* (*PRs*) are not mentioned explicitly in most pieces of legislation, leading to lack of clarity on the terminology used. To improve the way of dealing with this type of vulnerability and to allow organizations to successfully manage *PRs*, this work proposes and characterizes a workable problem-solving method in which the *PRs* can be evaluated for the entropy they generate within the organization. The analysis and development of such a system is based on a series of logical formalisms for *Knowledge Representation and Reasoning* that are grounded on *Logic Programming*, complemented with an *Artificial Neural Network* approach to computing.

Keywords: Psychosocial Risk Management; Entropy; Knowledge Representation and Reasoning; Logic Programming; Artificial Neural Networks

* Corresponding author. Tel.: +351-266745315; fax: +351-266745303.
E-mail address: hvicente@uevora.pt

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1. Introduction

PsychoSocial Risk Management (*PSRM*) is the application of the risk management framework to psychosocial risks in the workplace. As such it is based on the principles of prevention in line with occupational health and safety legislation, and it aims at risk elimination or reduction. Indeed, the labor law provides that one of the employer's obligations is to identify the risks to which workers are exposed, namely chemical, biological, physical, ergonomic or psychosocial risks. The exposure of workers to psychosocial risks in organizations has increased and has therefore been progressively examined [1]. Interest in identifying psychosocial risks in the workplace began in 1950 and augmented in 2000 after a rise in serious accidents at work [2]. Psychosocial risks are still a challenge for health at work and the safety of professionals [3]. Psychosocial hazards arise from organizational and work-related problems such as workload and rate, working hours, control, environment and equipment, culture and organizational functions, interpersonal relationships, career development or interaction between work and family, just to name a few [4]. In addition, work-related fluctuation, new recruitment options, hierarchy, work performance, an aging workforce and the need for overtime lead to emotional instability [1, 3]. These are the factors that can lead to stress, depression and absenteeism. Although organizations are required by law to identify and assess the risks and dangers associated with tasks, the involvement of all employees is of paramount importance in order to foster organization's operationally [4]. The article is divided into five sections. Following the introduction, a new section is presented that examines the basics used in this work, namely the concept of Entropy, the use of Logic Programming for Knowledge Representation and Reasoning [5, 6], and an approach to computing grounded on Artificial Neural Networks [7, 8]. Section 3 presents the methods followed in this work and address the thematic of a thermodynamics approach to data processing. Section 4 presents the computational models. Then conclusions are drawn and future work outlined.

2. Fundamentals

2.1. A thermodynamics approach to knowledge representation and reasoning

The approach proposed in this paper is grounded on *thermodynamics* that describe *Knowledge Representation and Reasoning* (*KRR*) practices as a process of energy devaluation [6, 9, 10]. In order to describe the fundamentals of the proposed approach, one must consider the *first* and the *second laws* of *thermodynamics*. The former one, also known as the *energy conservation law*, state that the total energy of an isolated system cannot change, i.e., is conserved over time. In other words, energy can be converted, but not generated or destroyed. The latter deals with *entropy*, a property that quantifies the state of order of a system and its development. Indeed, entropy is a measure of perturbation in a closed system. Under the second law, entropy in a system almost always increases over time – you can work to tidy up a system, but even the work put into reorganization increases the disorder as a by-product – usually in the form of heat. Since the entropy measure here is based on truth values that lie in the interval 0… 1, it is possible that the entropy may decrease in a system. These features fit the proposed vision of *KRR* practices since the evolution of the universe of discourse over time is to be understood as a process of energy devaluation, i.e., the energy that determines the orderly state of a system and its evolution, is given here in terms of *exergy*, *vagueness* and *anergy* (as it is shown below), which is to be used in the sense of depreciation, but never in the sense of destruction, viz.

- *Exergy*, also referred to as available energy, or more specifically, as available work, is that part of the energy that can be arbitrarily used. In Fig. 1 (section 3.2), this is given by the dark colored areas;
- *Vagueness*, it stands for the energy that may or may not have been consumed. In Fig. 1 (section 3.2) it is given by the gray colored areas; and
- *Anergy*, that stands for an energetic potential that was not yet consumed, being therefore available, i.e., all the energy that is not *exergy*. In Fig. 1 (section 3.2) it is given by the dashed areas [6, 9, 10].

2.2. The logic programming framework

There are many approaches to *KRR* using the *Logic Programming* (*LP*) epitome, namely in the area of *model theory* and *proof theory*. in the present study the *proof theoretical* approach, in terms of an extension to the *LP* language for

KRR, is followed [5]. An *Extended Logic Program* (*ELP*) is, therefore, given by a finite set of clauses, in the form, viz.

$$
\begin{aligned}
&\{\\
&\quad \neg\, p \leftarrow not\ p, not\ exception_p\\
&\quad p \leftarrow p_1, \cdots, p_n, not\ q_1, \cdots, not\ q_m\\
&\quad ?\,(p_1, \cdots, p_n, not\ q_1, \cdots, not\ q_m)\ \ (n, m \geq 0)\\
&\quad exception_{p_1},\ \ \cdots\ \ , exception_{p_j}\ \ (0 \leq j \leq k),\quad being\ k\ an\ integer\\
&\}
\end{aligned}
$$

Program 1. The archetype for *ELP* picture.

where the first clause stands for predicate's closure, "*,*" denotes "*logical and*", while "*?*" is a domain atom denoting "*falsity*", the p_i, q_j, and p are classical ground literals, i.e., either positive atoms or atoms preceded by the classical negation sign $\neg$ [5]. Indeed, $\neg$ stands for a *strong negation* and speaks for itself, while *not* denotes *negation-by-failure*, or in other words, a flop in proving a given statement, once it was not declared explicitly. Under this formalism, every program is associated with a set of *abducibles* [11], given here in the form of exceptions to the extensions of the predicates that make the program, i.e., clauses of the form, viz.

$$exception_{p_1},\ \ \cdots\ \ , exception_{p_j}\ \ (0 \leq j \leq k),\quad being\ k\ an\ integer\ number$$

that stand for data, information or knowledge that cannot be ruled out. On the other hand, clauses of the type:

$$?\,(p_1, \cdots, p_n, not\ q_1, \cdots, not\ q_m)\ \ (n, m \geq 0)$$

also named *invariants*, allows one to set the context under which the universe of discourse has to be understood [6, 10].

2.3. Artificial neural networks

Artificial Neural Networks (*ANNs*) are human brain inspired computing tools. First appear in 1943 with the work of McCulloch and Pitts [12]. Up to 1969 there were significant developments to which the emergence of single-layer perceptron has made a significant contribution [13]. However, some limitations (e.g., the fact that a single-layer perceptron cannot solve the *XOR* problem) led to a decrease in interest in *ANNs* between 1969 and 1986. The aforementioned disadvantages were remedied in the 1980s, and research at *ANNs* increased again with the emergence of the back-propagation algorithm in 1986 [14], and stimulated posteriorly through the development of numerous fast gradient-based variants (e.g., *RPROP*) [15]. *Multi-Layer Perceptron* (*MLP*) is one of the most widespread *ANNs* architectures in which neurons are layered and only forward connections exist [16]. *MLP* design is typically done by trial and error using an uphill approach, starting with an initial architecture that is adjusted to minimize the internal error (e.g., *mean square error*) [7, 16]. This was the *ANN's* architecture used in this work, as a part of the *Waikato Environment for Knowledge Analysis* (*WEKA*) [17].

3. Case study

3.1. Methods

This study was carried out in a cryopreservation laboratory in northern Portugal. A total of 78 participants took part in this study. The ages of the participants ranged from 22 to 68 years (average age 39 ± 17 years), with 59% women and 41% men. A questionnaire to assess the perception of psychosocial risks in the workplace was created and used for a cohort of 78 employees. The questionnaire was divided into two sections, the first containing general questions (e.g., age, gender, academic qualifications of employees), while the second included statements on working conditions, interpersonal relationships and emotional feelings. The *WEKA* software was used to implement *ANNs* as stated above [17]. In each simulation, the database was randomly divided into two mutually exclusive partitions, i.e., the training and test sets.

3.2. A thermodynamics approach to data processing

In order to collect information about psychosocial risks in the workplace the participants were asked to "*tick the option that best reflects his/her opinion regarding each statement plus the option that reflects his/her feelings in system development"*, a procedure that will be explained below. The answer options were confined to the following scale, *viz*.

Strongly Agree (4), Agree (3), Disagree (2), Strongly Disagree (1), Disagree (2), Agree (3), Strongly Agree (4)

The statements under consideration were divided into three groups, namely (*Working Conditions Statements – Four Items* (*WCS – 4*), *Interpersonal Relationships Statements – Three Items* (*IRS – 3*), and *Emotional Feelings Statements – Four Items* (*EFS – 4*). The former one encompasses the statements, viz.

- *S1 – There are good working conditions;*
- *S2 – There are resources and equipment needed to perform the work;*
- *S3 – The work done is not monotonous and routine;* and
- *S4 – Work requires learning and ongoing updates.*

The second group includes the statements, viz.

- *S5 – There is a good relationship with your colleagues;*
- *S6 – There is good communication and sharing of information between colleagues;* and
- *S7 – The help and support of the colleagues are frequent.*

Finally, the third one comprises the statements, viz.

- *S8 – The situations of verbal violence are not recurrent;*
- *S9 – There is flexibility and understanding for family life;*
- *S10 – Work sometimes overlaps with social and family life;* and
- *S11 – The time you have is enough to accomplish your tasks.*

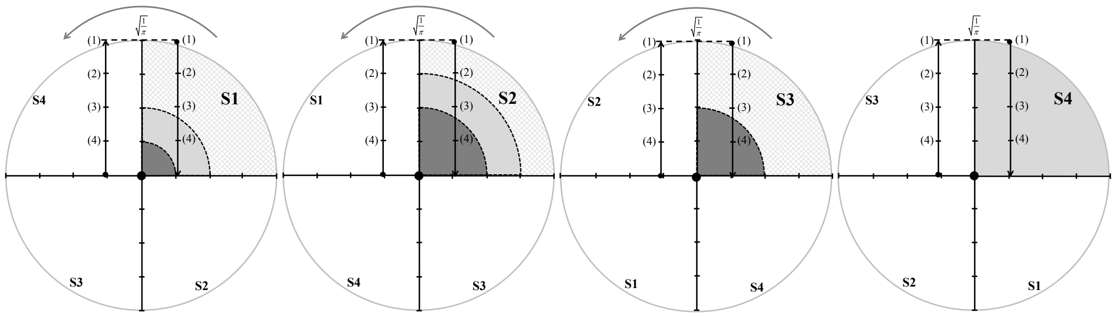
In order to quantify the qualitative information present in Table 1 and make the process intelligible, complete calculation details for *Working Conditions Statements – Four Items* (*WCS – 4*) *group* are provided. Thus, Table 1 shows the results regarding an applicant answer to the *WCS – 4* group. For example, the answer to *S1* was *strongly agree (4)* → *agree (3),* i.e., *the applicant* indicates that he *strongly agree (4)* with statement *S1*, but does not reject the possibility that the answer can be *agree (3)* in certain situations. It shows a trend in the development of the situation with added entropy, i.e., there is a deterioration of the overall environment, i.e., the psychosocial risks tend to increase. Otherwise, the answer to *S2*, *disagree (2)* → *agree (3),* shows a trend in the development of the system with a decrease in entropy, i.e., there is an improvement in the environment, i.e., the psychosocial risk tend to decrease. For *S3*, the answer was *agree (3),* a fact that speaks for itself, while for *S4* no options were indicated that indicate a vague situation, i.e., the value of the energy consumed is unknown, although it is known that it is in the interval 0 ... 1.

Figs. 1and 2 describes such responses regarding the different forms of energy, i.e., *exergy*, *vagueness* and *anergy*. Bearing in mind the fact that the markings on the axis correspond to one of the possible scaling options, the ecosystem performs better when the entropy decreases, which is the case with *S2*, as shown in Table 2 for the *Best and Worst Case Scenarios* (*BCS* and *WCS*). It should be noted that after normalizing the data to interval 0...1, the area of each circle is set to 1 (one), i.e., $Area_{circle} = \pi \times radius^2 = 1$, therefore $radius = \sqrt{(1/\pi)}$.

Table 1. An applicant replies to the *WCS – 4* group.

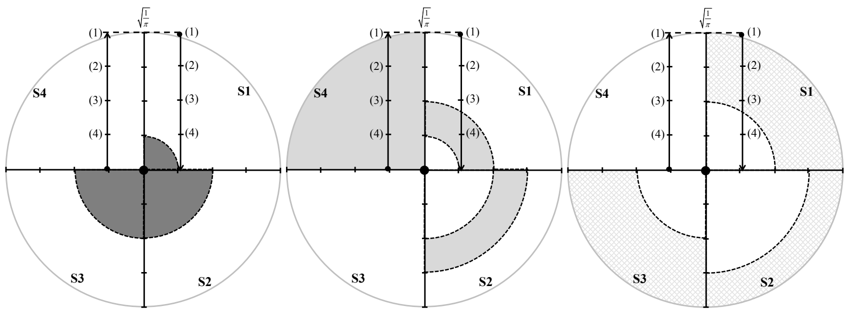
Statements	Scale							
	(4)	(3)	(2)	(1)	(2)	(3)	(4)	vagueness
S1	×	×						
S2					×	×		
S3						×		
S4								×

Leading to → Fig. 1 ← Leading to



Leading to → Fig. 2 ← Leading to

Fig. 1. A graphical representation of the entropic contribution of each question answer to the inclusive entropic status achieved face to an applicant's reply to the *WCS – 4* group. The dark, gray and dashed areas stand for *exergy*, *vagueness* and *anergy*, respectively.



Leading to → Table 2 ← Leading to

Fig. 2. A graphical representation of the inclusive entropic state attained in relation to an applicant's answer to the *WCS – 4* group. The dark, gray and dashed areas stand for *exergy*, *vagueness* and *anergy*, respectively.

Table 2. Evaluation of the entropic states for the *Best* and *Worst* case scenarios based on the *answers to the WCS – 4* group.

Statements	Best Case Scenario	Worst Case Scenario
S1	$exergy_{S_1} = \frac{1}{4}\pi r^2\Big]_0^{\frac{1}{4}\sqrt{\frac{1}{\pi}}} = \frac{1}{4}\pi\left(\frac{1}{4}\sqrt{\frac{1}{\pi}}\right)^2 - 0 = 0.02$	$exergy_{S_1} = \frac{1}{4}\pi r^2\Big]_0^{\frac{2}{4}\sqrt{\frac{1}{\pi}}} = 0.06$
	$vagueness_{S_1} = \frac{1}{4}\pi r^2\Big]_{\frac{1}{4}\sqrt{\frac{1}{\pi}}}^{\frac{2}{4}\sqrt{\frac{1}{\pi}}} = 0.04$	$vagueness_{S_1} = \frac{1}{4}\pi r^2\Big]_{\frac{2}{4}\sqrt{\frac{1}{\pi}}}^{\frac{2}{4}\sqrt{\frac{1}{\pi}}} = 0$
	$anergy_{S_1} = \frac{1}{4}\pi r^2\Big]_{\frac{1}{4}\sqrt{\frac{1}{\pi}}}^{\sqrt{\frac{1}{\pi}}} = 0.23$	$anergy_{S_1} = \frac{1}{4}\pi r^2\Big]_{\frac{2}{4}\sqrt{\frac{1}{\pi}}}^{\sqrt{\frac{1}{\pi}}} = 0.19$
S2	$exergy_{S_2} = -\frac{1}{4}\pi r^2\Big]_{\frac{2}{4}\sqrt{\frac{1}{\pi}}}^{0\sqrt{\frac{1}{\pi}}} = 0.06$	$exergy_{Q_2} = -\frac{1}{4}\pi r^2\Big]_{\frac{3}{4}\sqrt{\frac{1}{\pi}}}^{0} = 0.14$
	$vagueness_{S_2} = -\frac{1}{4}\pi r^2\Big]_{\frac{3}{4}\sqrt{\frac{1}{\pi}}}^{\frac{2}{4}\sqrt{\frac{1}{\pi}}} = 0.08$	$vagueness_{S_2} = -\frac{1}{4}\pi r^2\Big]_{\frac{3}{4}\sqrt{\frac{1}{\pi}}}^{\frac{3}{4}\sqrt{\frac{1}{\pi}}} = 0$
	$anergy_{S_2} = -\frac{1}{4}\pi r^2\Big]_{\sqrt{\frac{1}{\pi}}}^{\frac{3}{4}\sqrt{\frac{1}{\pi}}} = 0.11$	$anergy_{S_2} = -\frac{1}{4}\pi r^2\Big]_{\sqrt{\frac{1}{\pi}}}^{\frac{3}{4}\sqrt{\frac{1}{\pi}}} = 0.11$
S3	$exergy_{S_3} = -\frac{1}{4}\pi r^2\Big]_{\frac{2}{4}\sqrt{\frac{1}{\pi}}}^{0} = 0.06$	$exergy_{S_3} = -\frac{1}{4}\pi r^2\Big]_{\frac{2}{4}\sqrt{\frac{1}{\pi}}}^{0} = 0.06$
	$vagueness_{S_3} = -\frac{1}{4}\pi r^2\Big]_{\frac{2}{4}\sqrt{\frac{1}{\pi}}}^{\frac{2}{4}\sqrt{\frac{1}{\pi}}} = 0$	$vagueness_{S_3} = -\frac{1}{4}\pi r^2\Big]_{\frac{2}{4}\sqrt{\frac{1}{\pi}}}^{\frac{2}{4}\sqrt{\frac{1}{\pi}}} = 0$
	$anergy_{S_3} = -\frac{1}{4}\pi r^2\Big]_{\sqrt{\frac{1}{\pi}}}^{\frac{2}{4}\sqrt{\frac{1}{\pi}}} = 0.19$	$anergy_{S_3} = -\frac{1}{4}\pi r^2\Big]_{\sqrt{\frac{1}{\pi}}}^{\frac{2}{4}\sqrt{\frac{1}{\pi}}} = 0.19$
S4	$exergy_{S_4} = \frac{1}{4}\pi r^2\Big]_0^{0} = 0$	$exergy_{S_4} = \frac{1}{4}\pi r^2\Big]_0^{\sqrt{\frac{1}{\pi}}} = 0.25$
	$vagueness_{S_4} = \frac{1}{4}\pi r^2\Big]_0^{\sqrt{\frac{1}{\pi}}} = 0.25$	$vagueness_{S_4} = \frac{1}{4}\pi r^2\Big]_{\sqrt{\frac{1}{\pi}}}^{\sqrt{\frac{1}{\pi}}} = 0$
	$anergy_{S_4} = \frac{1}{4}\pi r^2\Big]_{\sqrt{\frac{1}{\pi}}}^{\sqrt{\frac{1}{\pi}}} = 0$	$anergy_{S_4} = \frac{1}{4}\pi r^2\Big]_{\sqrt{\frac{1}{\pi}}}^{\sqrt{\frac{1}{\pi}}} = 0$

Leading to → Table 4 ← Leading to

The data collected can be structured in terms of the scope of the questionnaire on predictable working conditions *WCS – 4*, leading to the predicate, viz.

$$wcs\text{–}\ 4: \boldsymbol{EX}ergy, \boldsymbol{VA}gueness, \boldsymbol{AN}ergy, \boldsymbol{P}sycho\boldsymbol{S}ocial\text{-}\boldsymbol{R}isk\text{-}\boldsymbol{M}anagement, \boldsymbol{SU}stainability \rightarrow \{True, False\}$$

a construct that speaks for itself, the scope and formal description of which follows (Table 3 and Program 2). The evaluation of *PsychoSocial Risk Management* (*PSRM*) and *its SUstainability (SU)* for the different items that make the *wcs – 4* are now given in the form, *viz*.

- $PSRM$ is figured out using $PSRM = \sqrt{1 - ES^2}$ (Fig. 3), where ES stands for the exergy's that may have been consumed, a value that ranges in the interval $0 \ldots 1$. In the *best* case scenario, $ES = exergy$, while in the *worst* case scenario, $ES = exergy + vagueness$.

$PSRM_{BCS} = \sqrt{1 - (0.14)^2} = 0.99$ and $PSRM_{WCS} = \sqrt{1 - (0.51 + 0)^2} = 0.86$

- SU is evaluated in the form $SU = 1 - ES/Interval\ length(= 1)$.

$SU_{BCS} = (1 - 0.14)/1 = 0.86$ and $SU_{WCS} = \big(1 - (0.51 + 0)\big)/1 = 0.49$

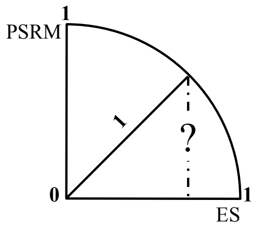


Fig. 3. *PSRM* evaluation.

Table 1 is now supplemented by Table 3, in which the answers of an applicant to the *IRS – 3* and *EFS – 4* groups are listed. The calculation process for each group of questions is the same as for *WCS – 4*. Table 4 shows the areas of the predicates that were determined based on the responses of one participant to the questionnaires *WCS – 4*, *IRS – 3* and *EFS – 4*.

Table 3. An applicant replies to the *IRS – 3* and *EFS – 4* groups.

Statements Group	Statements	Scale							
		(4)	(3)	(2)	(1)	(2)	(3)	(4)	vagueness
IRS – 3	S5						×		
	S6								×
	S7		×	×					
EFS – 4	S8								×
	S9					×			
	S10		×	×					
	S11						×		

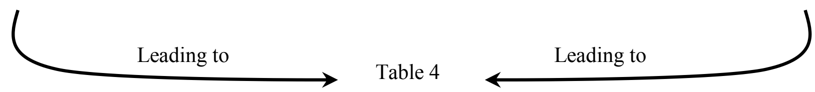


Table 4. The *working conditions statements* (*wcs – 4*), *interpersonal relationships statements* (*irs – 3*) and *emotional feelings statements* (*efs – 4*) predicates' scopes obtained according to an applicant answers to the *WCS – 4*, *IRS – 3* and *EFS – 4* groups.

Statements Group	Exergy BCS	Vague BCS	Anergy BCS	PSRM BCS	SU BCS	Exergy WCS	Vague WCS	Anergy WCS	PSRM WCS	SU WCS
WCS – 4	0.14	0.37	0.53	0.99	0.86	0.51	0	0.49	0.86	0.49
IRS – 3	0.17	0.44	0.50	0.98	0.83	0.60	0	0.40	0.80	0.40
EFS – 4	0.27	0.33	0.48	0.96	0.73	0.59	0	0.41	0.81	0.41

3.3. On the evaluation of psychosocial risks and computational models

In this subsection a mathematical-logical program is presented, with the help of which the perception of individuals or groups is evaluated and with them the organization as a whole is assessed, i.e., it measures the impact of psychosocial risks on the organization through logical reasoning (*Program 2*). Indeed, contextual programming is not new, but an unusual field that can help find or work out data. In addition, as often as *artificial intelligence* and *machine learning* is currently practiced, there was no way to ask the computer why this was the case. It is known how to teach an algorithm to identify a horse in a photo, but you cannot ask why it is a horse. This was the main reason why the system of information or knowledge representation was changed in this work. The focus is not on knowing the absolute value that a variable takes, but on quantifying the associated evolutionary process that caused a certain variable to take a certain value.

{

/* Predicate closure stands for the sentence below that states that the extent of predicate wcs – 4 is made on the clauses that are explicitly stated plus the ones that cannot be discarded (i.e., the exceptions)*/

$$\neg\, wcs-4\,(EX,\ VA,\ AN,\ PSRM,\ SU) \leftarrow not\ wcs-4\,(EX,\ VA,\ AN,\ PSRM,\ SU),$$
$$not\ exception_{wcs-4}\,(EX,\ VA,\ AN,\ PSRM,\ SU).$$

/* The sentence below denotes a wcs – 4 axiom*/

$$wcs-4\,(0.14,\ 0.37,\ 0.53,\ 0.99,\ 0.86).$$

/* Predicate closure stands for the sentence below that states that the extent of predicate irs – 3 is made on the clauses that are explicitly stated plus the ones that cannot be discarded (i.e., the exceptions)*/

$$\neg\, irs-3\,(EX,\ VA,\ AN,\ PSRM,\ SU) \leftarrow not\ irs-3\,(EX,\ VA,\ AN,\ PSRM,\ SU),$$
$$not\ exception_{irs-3}\,(EX,\ VA,\ AN,\ PSRM,\ SU).$$

/* The sentence below denotes a irs – 3 axiom*/

$$irs-3\,(0.17,\ 0.44,\ 0.50,\ 0.98,\ 0.83).$$

/* Predicate closure stands for the sentence below states that the extent of predicate efs – 4 is made on the clauses that are explicitly stated plus the ones that cannot be discarded (i.e., the exceptions)*/

$$\neg\, efs-4\,(EX,\ VA,\ AN,\ PSRM,\ SU) \leftarrow not\ efs-4\,(EX,\ VA,\ AN,\ PSRM,\ SU),$$
$$not\ exception_{efs-4}\,(EX,\ VA,\ AN,\ PSRM,\ SU).$$

/* The sentence below denotes a efs – 4 axiom */

$$efs-4\,(0.27,\ 0.33,\ 0.48,\ 0.96,\ 0.73).$$

}

Program 2. The structure of the logic program or the knowledge database built on an applicant answers to the *WCS* – 4, IRS – 3 and EFS – 4 groups.

In order to obtain an assessment of the *PsychoSocial Risk Management* (*PSRA*) and a measure of its *SUstainability* (*SU*) of someone on the fly, a cohort of 78 applicants was enrolled with the aim of training an *ANN* to answer such must. The training and test sets were gotten by clarifying the theorem [7, 8] (Fig. 4), viz.

$$\forall\left((EX_1, VA_1, AN_1, PSRM_1, SU_1), \cdots, (EX_3, VA_3, VA_3, PSRM_3, SU_3)\right),$$
$$\left(wcs\!-4\,(EX_1, VA_1, AN_1, PSRM_1, SU_1), \cdots, \left(efs\!-4\,, (EX_3, VA_3, VA_3, PSRM_3, SU_3)\right)\right),$$

in every possible way, i.e., generate all different possible sequences that combine the dimensions of the predicates *wcs – 4*, *irs – 3* and *efs – 6*, viz.

$$\left\{\{wcs\!-4\,(EX_1, VA_1, AN_1, PSRM_1, SU_1), \cdots, efs\!-4(EX_3, VA_3, VA_3, PSRM_3, SU_3)\}, \cdots\right\} \approx$$
$$\approx \left\{\{wcs\!-4\,(0.14, 0.37, 0.53, 0.99, 0.86), \cdots, efs\!-4\,(0.27, 0.33, 0.48, 0.96, 0.73)\}, \cdots\right\}$$

where *{}* is the symbolization for sets and ≈ stands for itself. With regard to the output of the *ANN*, the output values include both the *PsychoSocial Risk Management* (*PSRM*) and a measure of its sustainability (*SU*), that are evaluated, for the best case scenario, in the form, viz.

$$\left\{\left\{\left(PSRM_{wcs-4} + PSRM_{irs-3} + PSRM_{efs-4}\right)/3\right\}, \cdots\right\}_{BCS} \approx \left\{\{(0.99 + 0.98 + 0.96)/3 = 0.98\}, \cdots\right\}_{BCS}$$

and viz.,

$$\left\{\left\{\left(SU_{wcs-4} + SU_{irs-3} + SU_{efs-4}\right)/3\ \right\}, \cdots\right\}_{BCS} \approx \left\{\{(0.86 + 0.83 + 0.73)/3 = 0.81\}, \cdots\right\}_{BCS}$$

With respect to the worst case scenario, the *PSRM* and *SU* are evaluated in a similar way which output is given in the form, viz.

$$\left\{\left\{\left(PSRM_{wcs-4} + PSRM_{irs-3} + PSRM_{efs-4}\right)/3\right\}, \cdots\right\}_{WCS} \approx \left\{\{(0.86 + 0.80 + 0.81)/3 = 0.82\}, \cdots\right\}_{WCS}$$

and viz.,

$$\left\{\left\{\left(SU_{wcs-4} + SU_{irs-3} + SU_{efs-4}\right)/3\ \right\}, \cdots\right\}_{WCS} \approx \left\{\{(0.49 + 0.40 + 0.41)/3 = 0.43\}, \cdots\right\}_{WCS}$$

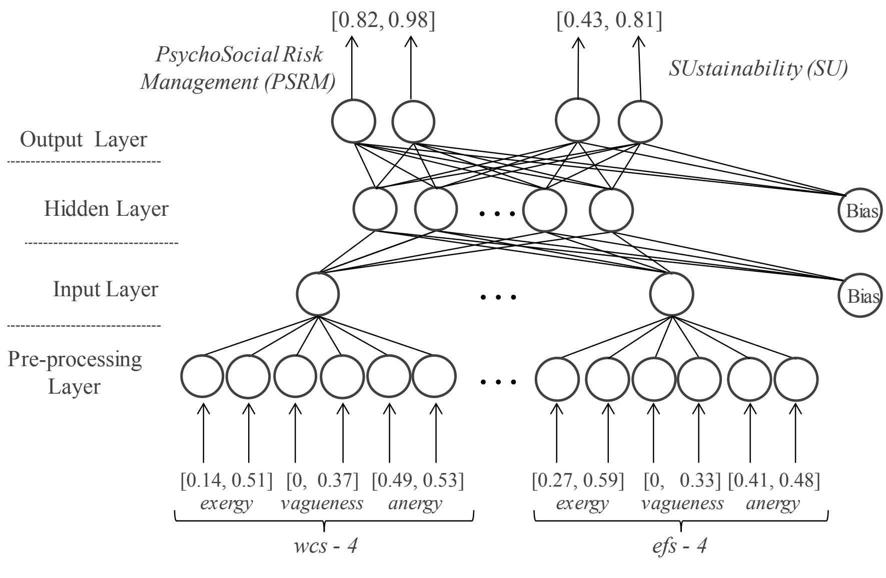


Fig. 4. An abstract view of the topology of the ANN for the assessment of *psychosocial risks* evaluation.

4. Conclusions and future work

Currently, the assessment of *psychosocial risks* is left to each organization's criterion. however, the standards used do not make clear how these risks should be measured. even in certified organizations, there is no guarantee that psychosocial risks are actually managed. this study presents a data collection and computational model that intends to give an answer to this problem based on *mathematical logic* and the *laws of thermodynamic*. this approach focuses on processing information collected through questionnaire surveys to prevent recurring events. in future work and pondering how the various factors can influence the individual's perception of *psychosocial risks*, new groups of statements such as organizational management, leadership, power or justice will be taken into account.

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