A formal representation of terms and processes for the transition from risk to resilience and sustainability management

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Starting point of discussion in this paper is the well established concept of risk and risk management at organisations. However, this concept becomes currently challenged because of new stakeholders requirements as resilience and sustainability. This raises the question for organisations to what extent these three concepts are compatible in management processes and where, at best, a transformation from risk to resilience and sustainability (RRS) can take place. To answer this question a formal framework of management processes in general is presented. For this purpose the St. Gallen Management Model and the (risk) management process according to ISO-31000 is transferred to a Class Diagram (CD) to depict the common view of a management framework. Then, the attributes of classes are identified and specified for RRS by literature research and with regard to operational aspects resulting in a comparative CD. Maturity and level of usefulness are evaluated and ranked. As a result, organisations view RRS mainly as a monetary task which, then, enables them to male a (simplified) transformation towards integrative management processes. However, the usual more comprehensive definitions of these terms and their lack of standardisation contradict this simple approach. The paper shows the use of CDs to compare RRS management processes and the resulting interfaces and tasks for organisations.

Keywords: risk, resliience, sustainability, management, class diagram.

1. Introduction

The management of an organisation also has the duty to be prepared for deviations from the planned. Risk management is an established way of doing this. However, other terms are currently emerging in theory and practice widening this duty or interpreting it differently to risk, e.g., such as resilience and sustainability. Risk, then, frames a description of (mainly) unwanted short-term conditions, whereas resilience and sustainability name longer-term and wanted objectives. Taking these terms in all seriousness, they consequently trigger differing management processes.

The paper examines risk, resilience and sustainability (RRS) management from the perspective of an organisation or company, where the focus is on operational processes. The aim is to formalise RRS management processes to such an extent that differences and similarities become apparent. This provides hints as to where risk management can be extended and where obstacles exist. The remaining paper is structured as follows: Chapter 2 specifies the common management processes at organisations and converts them into the formal framework of a class diagram (CD). Chapter 3 substantiates the RRS management structures and processes by complementing the CD previously developed. The findings are summarised and evaluated in chapter 4 with regard to maturity levels and usefulness in the viewpoint of organisations. Finally, chapter 5 compiles pro and cons of the approach and derives recommendations for the transition from risk to resilience and sustainability management.

2. Structuring Management

The first task is to formalise management structures and processes of organisations. For this, clarification of these terms is needed: an organisation is defined as "an organized group of people with a particular purpose, such as a business or government department" OUP. A general management system is defined by "the totality of all organisational measurements which are appropriate to control processes in order to ensure the achievement of the specified business objectives" (Felix et al.). Hence, RRS are understood as subsets of these objectives.

It is hereafter assumed the organisation has already specified its purposes and objectives in long-term and short-term ranges (i.e. its vision and mission) with regard to (minimise) risks, (increase) resilience and (achieve) sustainability. For this, the organisation needs to set strategies, processes and an active corporate culture (Rühli; Rühli et al.; Rühli et al.). The instances of these structuring forces are core elements according to the St. Gallen Management Model (SGMM) of Rüegg-Stürm et al., which is used in this paper for further structuring purposes. According to the SGMM, the internal core of an organisation is structured by:

Proceedings of the 30th European Safety and Reliability Conference and the 15th Probabilistic Safety Assessment and Management Conference
Edited by Piero Baraldi, Francesco Di Maio and Enrico Zio
Published by Research Publishing, Singapore.
ISBN: 978-981-14-8593-0; doi:10.3850/978-981-14-8593-0

- *Structuring Forces*: strategy, structures, culture
- *Processes*: Management, business, support
- *Modes of Development*: renewal, optimisation.

This core is encapsulated in external

- *Interaction Issues*: strategy, norms and values, concerns and interests
- *Environmental Spheres*: society, nature, technology, economy.

The environmental spheres are represented by stakeholders (investors, customers, employees, public/media/NGOs, government, suppliers, competitors). Although stakeholders affect an organisation from outside, employees can have a dual role, for example, as employees and customers.

ISO-31000 structures management processes with regard of risk management. According to this standard, risk management is

- facing "external and internal factors and influences that make it uncertain whether they will achieve their objectives"
- "...setting strategy, achieving objectives and making informed decisions."
- improving management systems in general
- covering "all activities associated with an organization and includes interaction with stakeholders."

ISO-31000 is is sufficient for the paper to characterise the management of assessment processes in general. Together with the SGMM all information is available for formal representation of the RRS management processes by CDs.

A CD formally "...describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects" (wikipedia.org). "Classes are represented by rectangles which show the name of the class and optionally the name of the operations and attributes. Compartments are used to divide the class name, attributes and operations" (sparxsystems.com). Packages group classes. There are two types of associations (i.e., links) among classes: Full lines show strong information flows and doted lines weaker ones. For an improved presentation in the paper the following notation applies: Package names are in bold text, class names are in italics. The management structures of an organisation can then be represented as shown in Fig. 1. It identifies three major areas: First, *Stakeholder* affect the management of an organisation as independent entities from outside. Second, **Management** combines the internal classes of an organisation as, finally, needed for RRS management purposes. *Force* takes the requirements of *Stakeholder* to specify and implement the specific strategies, structures and culture of the organisation. *Interaction_issue* specifies scope, available resources, etc., for (RRS) assessments. **Assessment** shows the core elements of assessment (*Identification*, *Analysis*, *Evaluation*)

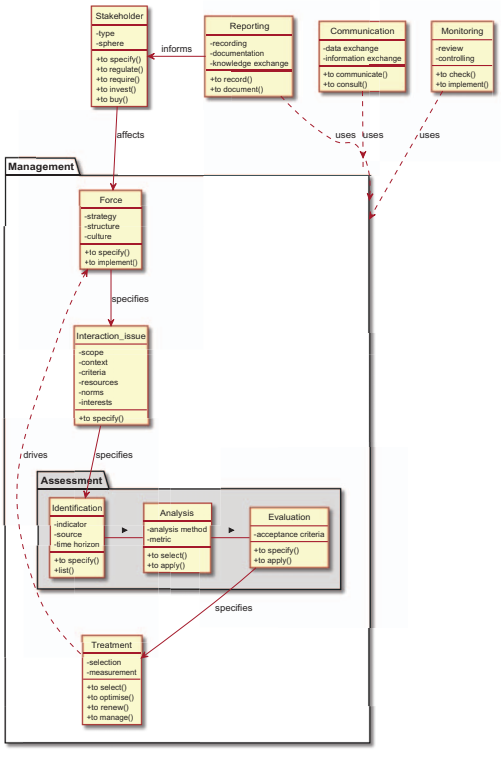

Fig. 1. Class diagram of organisational management based on the St. Gallen Management Model of Rüegg-Stürm et al. and the generalised risk management model from ISO-31000.

as,e.g., defined by ISO-31000. The major information flow of assessment activities is from identification towards evaluation (labeled as triangles). However, the assessment activities often bases on mutual information exchange within an organisation. Hence, the association in use is undirected. The output of *Evaluation* is needed to manage the *Treatment* of any optimising measurements. The way of *Treatment* might have an impact to redefine the strategy of the organisation, i.e., *Force*. *Reporting*, *Monitoring*, and *Communication* are considered as auxiliary activities using the outputs of **Management**, e.g., to inform the stakeholders about RRS management activities and results.

Fig. 1 also shows two PDCA (Plan-Do-Check-Act) loops: Internal, from *Focus* to *Treatment* and back to *Focus* (which is also in line with Rühli and ISO-31000). The external loop is the mutual inference flow from *Stakeholder* and **Management** by *Reporting*.

3. RRS Management

The generic management framework as structured by CD in chapter 2 needs to be specified for RRS management frameworks. The definitions

of risk and resilience and depicting them by CDs have already been presented by Mock et al. Thus, this chapter only deals with sustainability in more detail and also develops a (simple) CD for this purpose.

Resilience and sustainability frameworks also uses key terms from risk analysis. The following definitions from IET will apply for subsequent clarification of contexts: Safety is the "freedom from (unacceptable) risk of harm to persons. Safety may also encompass environmental or asset damage/loss". Hazard is "a potential source of harm". With this, safety as well as hazard are clearly associated with risk.

The descriptions in this chapter refer to Fig. 3 at the end of the paper. The instances of classes are largely self-explanatory.

3.1. *Risk*

The context of operational risk is a well established in business, society and organisations and the Frequeny/Concequence (F/C) concept of risk is supposed to be known to the reader.

With regard to Fig. 3, *Stakeholder* acting in the sphere of technology encompasses government (authorities) responsible for normative and monitoring issues in risk and related disciplines in the context of reliability, safety and security. *Stakeholder* of this sphere (public, media, NGOs) are interested in to "reduce risks, protecting people" as specified by HSE. *Force* specifies the management's strategy, structure and culture with regard to risk. Strategy, then, is operation under acceptable risks, i.e., safe operation. The organisational and technical structure to follow this strategy needs to be implemented, e.g., Defence-in-Depth and establishing PDCA cycles to improve safety over operation time. The organisation's risk culture, hence follows the principles of safety culture, awareness, and risk governance. ISO-31000 provides most of the Attributes in *Interaction_issue*.

It is important to know scope and available resources before conducting any assessment. Risk assessment ia a state-of-the-artapproach and domain experts refer to many Best Practices and standards. There, accidental (undesired) events are taken into account for risk and hazard identification. Hence, the time horizon of interest is characterised as sudden. *Analysis* selects and applies the appropriate method(s) to analyse the identified risks. Methods in use are standardised and given, e.g., by ISO-31010. Typical representatives are Bow Tie Analysis, Failure Mode and Effects Analysis (FMEA), and Fault Tree Analysis. *Analysis* names the established a risk metric (e.g., F/C).

This short presentation shows that CDs are an appropriate approach to depict and supplement the familiar risk management procedures. This proof-of-concept encouraged the authors to map resilience and sustainability management in the same way.

3.2. *Resilience*

Resilience is lively discussed in academia as in, e.g., various ESREL conferences. A wide variety of resilience definitions exists, as elaborated in detail in Mock et al. showing that "resilience mainly considers entity and deviation" (and risk is mainly constructed around impact). However, binding definitions are essential for the management of organisations (*cf.* Mock et al.). The authors uses the characterisation of resilience in ISO-37151 as definition, which specifies the needs from the perspective of community managers: "Resilience: This means that community infrastructure systems are designed to continue providing services in emergencies and to quickly recover from damage and suspension of services". This auxiliary definition of resilience summarises the general understanding of this term sufficiently well for this paper purposes. Important keywords are: continuous service and recoverability. *Stakeholders* are nearly the same types as in risk management. However, resilience analysis base on extended system boundaries as exemplified in Leksin et al. Thus, an extended number of actors affect system resilience and must be included in the resilience assessment (e.g., prosumer of power in smart power grids).

Management shows greater commonalities with the risk management process flow (Fehling-Kaschek et al.; Mock et al.) in dealing with management of short-term incidents causing performance disturbances. With regard to *Force*, the strategy also considers (long-term) system operation, i.e., continuous performance. Similarities with Business Continuity Management are emergent (cf. ISO-22313).

In **Assessment** major problems arise for organisations to find applicable (and standardised) resilience indicators (cf. Mock et al.). Hence, there are lacks in applied resilience analysis and evaluation. (Reference is made to the definition efforts of resilience in Mock et al. and Hupp et al.).

The authors conclude that a basic understanding of resilience among stakeholders and the management of an organisation is at least implicit. However, the lack of a regulatory framework comprising the resilience assessment in organisations is a major obstruction of implementation.

3.3. *Sustainability*

The United Nations (UN) are a major *Stakeholder* of sustainable development (SD). Brundtland ("Brundtland Report") gives the most common definition in the context of sustainability: "Humanity has the ability to make development sustainable to ensure that it meets the needs of the

present without compromising the ability of future generations to meet their own needs". The UN Sustainable Development Goals (SDG) Goal 12: Ensure sustainable consumption and production patterns give some guidelines to concretize the transformation towards sustainable management (SM) in organisations. Relevant sub-goals are:

- 12.1 Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries
- 12.2 By 2030, achieve the sustainable management and efficient use of natural resources
- 12.6 Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle.

With this, some keywords for CD development are given: production, efficient use of resources, and reporting. Environmental management systems are also addressed by ISO-14001. The following results of a literature research summarise the state of implementation at organisations.

Moldavska et al. state that the definition of SM according to U.S. Department of Commerce, 2008, has a major impact on the general definition of this term: SM "... is the creation of manufactured products through economically-sound processes that minimize negative environmental impacts while conserving energy and natural resources. SM also enhances employee, community and product safety." (This definition can now be found on EPA.) The use of the term "safety" makes a reference to risk (see section 3.1). The EPA definition is the implementation of the Triple Bottom Line (TBL) "People, Planet, Profit" characterising the conventional spheres of influence of sustainability. Tschandl et al. also summarise some motives and examples for implementing sustainable economic activities. This list is enriched with benefits of corporate sustainability management according to Baumgartner et al. [in square brackets]:

- Legitimation and acceptance by reputation and trust (e.g., motivation of employees) [improvements in reputation and legitimacy]
- Chances for market, differentiation and innovation (e.g., increased market share) [improvements in competitiveness]
- Value orientation of stakeholders (e.g., personal validity system of owners) [creation of value by seeking win-win outcomes].

Fig. 2 integrates the previous findings and keywords into a CD. The class attributes will be integrated later in Fig. 3.

The TBL concept and the broad variety of motivations indicate that sustainability concerns all types in *Stakeholder* and, hence, all spheres.

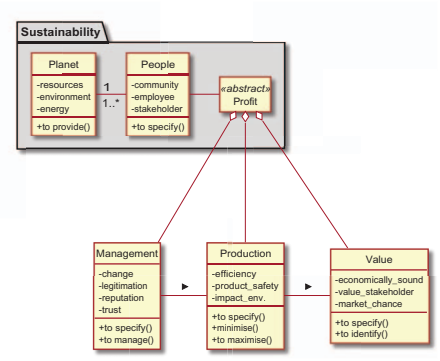

Fig. 2. Class Diagram of sustainability.

With regard to *Force*, Baumgartner et al. states that this "is to reduce the negative environmental and social impacts of corporate activities ..." – "However, in its basic normative and ethical form, the concept of sustainable development offers no clear guidance with regard to which strategies, plans or activities need to be implemented" for industrial organisations. They also state that "the economic benefit of corporate sustainability management [of industrial organisations] in a narrow sense is based on reduced costs or increased revenues". In reality, organisations often have to deal with conflicting goals and trade-offs by applying the TBL concept. Moldavska et al. claim that "there is a wide deviation from the core understanding of the SM concept, i.e., number of issues associated with SM" and "the vast majority related SM to product, process, community, employees, and customers". They also conclude "...that inconsistency in the understanding of issues associated with the SM concept results in the lack of a unified terminology and vocabulary." Tschandl et al. and Baumgartner et al. [in square brackets] name the minimising and management of risks (e.g., lower losses) [reductions in risks]. In summary, the context of *Force* looks blurry to organisations. The context of sustainability at most organisations is economic and value driven.

With regard to *Interaction_issue*, sustainability and SD demands of a national and for a long-term oriented strategy. "For manufacturing organizations to contribute to SD, this requires long-term thinking hand in hand with short-term actions" Moldavska et al. Tschandl et al. and Baumgartner et al. [in square brackets] also hint improved productivity by eco and socio efficiency (e.g., lower cost of resources) [reductions in costs]. Again, this strengthens the findings in *Force* that organisations mainly associate sustainability with costs and financial risks. It indicates a conflict in the practical implementation of SM: "The integration of environmental and social issues into corporate mid-term and long-term goals demands that a

careful balance is achieved between the needs of internal and external stakeholders" Baumgartner et al.

With regard to **Assessment** the literature reviewed for this paper draws clear conclusions about which indicators are relevant for organisations. Moldavska et al. found that "in the context of SM, two types of integrations prevail: integration of business elements, and integration of sustainability dimensions with business elements". This is in accordance with *Force* and *Interaction_issue*. Baumgartner et al. identify two levels: "While assessing the impact of business activities, one needs to take both first- and second-order levels of sustainability into account. First-order levels are related to narrow issues of efficiency, while second-order levels are broader, and more closely related to systemic effectiveness." The literature research of Hörisch et al. summarise the most common indicators of Corporate Environmental Performance (CEP) as shown in Tab. 1.

Table 1. Major CEP indicators in use acc. to Hörisch et al.

Description	Unit
Total mass of GHG emissions divided by net sales or revenue	t/k$
Total amount of waste produced divided by net sales or revenue	t/k$
All real or estimated penalties, fines from lost court cases, settlements or cases not yet settled regarding environmental controversies	k$
Total amount of materials used divided by net sales or revenue	t/k$
Total direct and indirect energy consumption divided by net sales or revenue	GJ/k$
Volume of water withdrawal divided by net sales or revenue	m^3/k$
Has the company received product awards with respect to environmental responsibility?	Yes/no

t: ton; k$: thousand US dollars; GJ: Gigajoules; m^3: cubic meter

There are clear preferences about the time horizon of an assessment to be covered: "[. . .] industry leaders tend to focus on short-term issues rather than longer-term issues . . . , and short-term performance is frequently prioritized over long-term performance . . . " (Moldavska et al.). This information completes the description of the indicators in Tab. 1 in terms of measurement duration. In summary, *Identification* defines indicators associated with costs and measuring short-term consumptions.

Analysis bases on analysis methods to calculate costs in general or by substances or energy used or released. This might be part of Life Cycle Cost Analysis (LCCA). This points to approaches to quantify the CEP indicators of Tab. 1. As mentioned in *Identification*, short-term performances are measured. However, short-term is in terms of business activities (months, annual), which is characterised as mid-term or long-term in time horizon of *Identification*. For *Evaluation* purposes, an organisation may define marginal costs for its sustainability indicators. Over longer periods of time, trends can be presented then, e.g., increasing (costs of) waste produced which then is regarded as not acceptable. (On national level see, e.g., the Swiss MONET 2030 indicator system of FSE). For short, *Treatment* then encompasses the reduction of unacceptable costs or substances or energy used.

In summary, in the context of organisation management, sustainability is value and business orientated where in contrast many stakeholders also follows the TBL concept. This conflict is indicated by attribute "TBL sustainability" in *Stakeholder* and "minimising finacial risks" in *Interaction_issue*.

4. Synopsis and Evaluation

This chapter gives an synopsis of findings as compiled in chapter 3 and a conclusive rating of CD management classes with regard to their maturity and usefulness. Fig. 3 first shows characterising keywords specifying the attributes of classes of Fig. 1 with regard to risk (in red), resilience (blue) and sustainability (green). Obvious gaps were closed straight-away by the authors, the remaining ones are marked with a question mark.

The illustration shows that each management subject is affected by different groups of stakeholders. Risk is typically affected by authorities and insurance companies, while resilience and sustainability are presumably more influenced by the public. In **Management** it is noticeable that risk and sustainability have been allocated clear objectives and resulting attributes. However, there is a conflict in the understanding of sustainability, i.e., TBL sustainability versus production costs. The assignments of attributes in terms of resilience are not clear. Stakeholders demand for resilience in terms of system stability, service continuity and availability. However, these terms are already associated with well established issues of reliability and business continuity management (cf. Möhle). The authors suspect that there is a high possibility that resilience often becomes a (redundant?) renaming of well-known principles.

There are essential differences of time horizons of impact duration and achievement of objectives: Risk is about sudden, accident-like events. Provided that the lifetime of a system is long-term (years), then resilience includes (short) disturbances, but requires long-term stability. Sustainability, on the other hand, is ultimately a goal to be achieved in the longer term.

The next step attempts to roughly assess the degree of maturity of RRS management structures as well as the usefulness in the view of organisations. The estimation of maturity assessment follows the

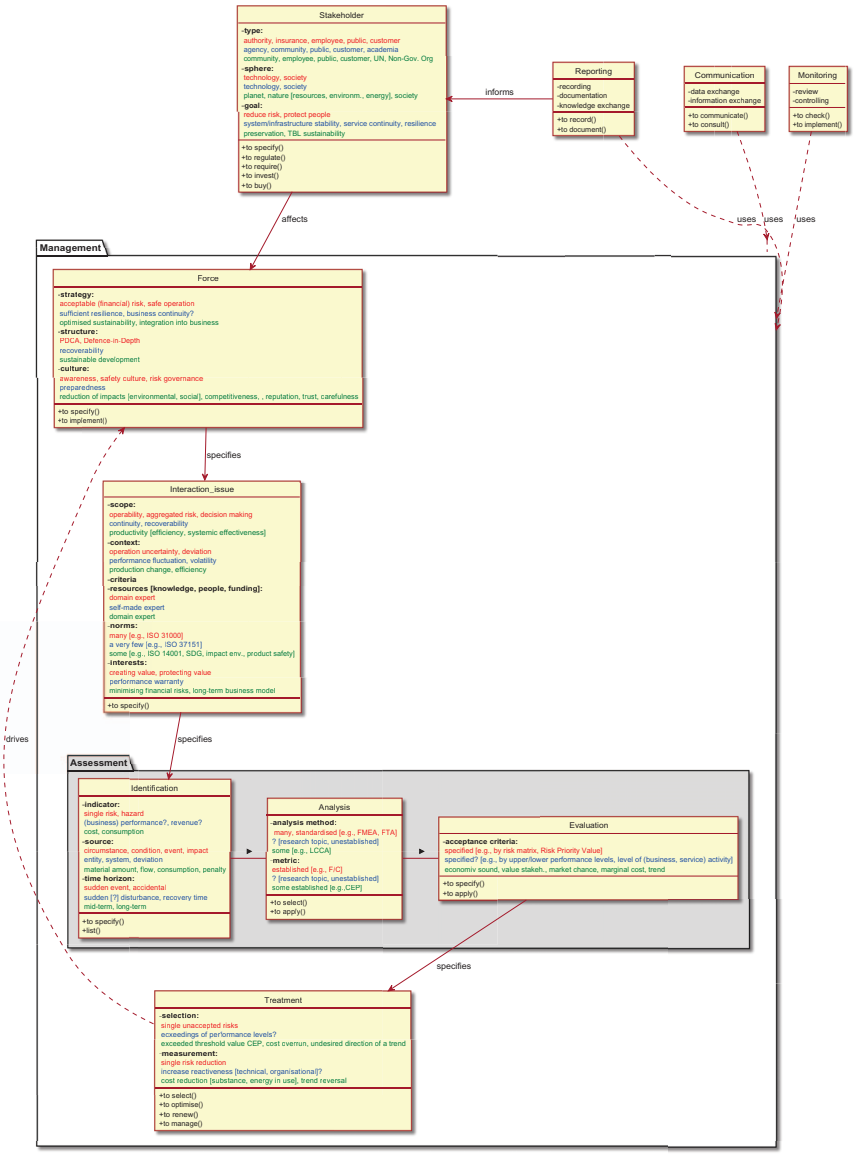

Fig. 3. Comparative Class Diagram of RRS management processes (red: risk; blue: resilience; green: sustainability.)

ideas as presented by Bukowski. Maturity levels in use are:

- 0: immature
- 1: appropriable
- 2: mature.

Tab. 2 gives identification rules to estimate the maturity levels of the six management classes of Fig. 3. As all classes are relevant for the overall management process, the overall maturity level is immature if there is at least one class immature. Full maturity needs at least four mature classes. These values results in sets indicating the reached overall maturity level. The second assessment

Table 2. Rules for maturity level assessment of management.

Level	Identification Rule	Set
0:	At least on class is 0	$\rightarrow \{0\}$
1:	$(2^0 \cap 1^6 \cap 0^0) \cup (2^1 \cap 1^5 \cap 0^0) \cup (2^2 \cap 1^4 \cap 0^0) \cup (2^3 \cap 1^3 \cap 0^0)$	$\rightarrow \{1;2;4;8\}$
2:	$(2^4 \cap 1^2 \cap 0^0) \cup (2^5 \cap 1^1 \cap 0^0) \cup (2^6 \cap 1^0 \cap 0^0)$	$\rightarrow \{16;32;64\}$

looks at the usefulness of a class for the organisation from a management perspective. Ratings are:

- +: nice to have
- ++: beneficial
- +++: compulsory

Tab. 3 shows and summaries all ratings of maturity and usefulness of RRS management. The ratings

Table 3. Maturity M of and usefulness I of classes of risk (R), resilience (Re), and sustainability (S).

Class	**R**		**Re**		**S**	
	M_R	I_R	M_{Re}	I_{Re}	M_S	I_S
Force	2	+++	1	++	1	+
Interaction_issue	2	+++	1	+	1	+
Identification	2	+++	1	+	2	++
Analysis	2	+++	0	+	2	+
Evaluation	2	+++	0	+	1	++
Treatment	2	+++	0	+	1	+
Level	2	+++	0	+	1	+(+)

of Tab. 3 are driven by the assumptions that risk management is widely regulated and established at organisations. Resilience management as a discipline in its own right does not yet exist or is only in its infancy. Sustainability management is established and accepted as far as it considers effectiveness and costs. However, the broad TBL approach is not fully implemented. Piper strengthens this rating, where in-depth interviews with board members, senior management, and chief audit executives yielded a ranking of top risks facing organisations today and tomorrow.

Table 4. Risk ranking by relevance (Piper).

2020	**2024**
1. Cybersecurity (86%)	1. Cybersecurity (90%)
2. Data protection (78%)	2. Data protection (85%)
3. Regulatory change (66%)	3. Data & new technology (82%)
4. Business continuity (65%)	4. Business continuity (67%)
5. Data & new technology (64%)	5. Third party (66%)
6. Third party (60%)	6. Regulatory change (64%)
7. Talent management (58%)	7. Talent management (65%)
8. Culture (57%)	8. Data ethics (66%)
9. Board information (54%)	9. Culture (58%)
10. Data ethics (51%)	10. Board information (51%)
11. Sustainability (30%)	11: Sustainability (45%)

In Tab. 4 it is striking that risk is used in the sense of hazard and resilience is not mentioned (or paraphrased by business continuity). Four risks out of eleven concern areas of ICT. Sustainability remains in last place reflecting a continuous lower level of interest.

Tables 3 reflect the authors' rankings of the degree of maturity and usefulness of RRS management processes. Risk management is mature (Level 2), with organisations seeing its usefulness (level +++). Since sustainability in organisations has been widely understood as an economic optimisation aspect, the applied procedures can be considered appropriable and beneficial. However, the complete, not only monetary TBL approach to sustainability is not fully implemented in management reasoning the lower rankings. Resilience in the sense of business continuity can be regarded as beneficial from the management's point of view. However, there is no standardised resilience assessment and the resilience management concept is considered as immature.

5. Conclusion

The conclusions are separated into a methodology and management part. The methodological part shows that a comparative RRS management model can be built from compiling a generic management model (SGGM) and the risk management process (ISO-31000) by CDs. The RRS specifications of class characteristics then show the management of an organization where strengths and weaknesses lie in the respective management process. The authors see this as a contribution to structure the discussion around RRS. The method of ranking the level of maturity and usefulness is primarily seen as an approach to express the organisational or corporate point of view.

With regard to the transformation of risk management, a simple transformation is possible if RRS are understood solely as monetary challenges: (operational) risks, then, mean potential financial losses, resilience is understood as business continuity (i.e., the avoidance of costs due to business interruption), and sustainability is an increase in resource efficiency and consequently a matter of cost avoidance. However, this simple transformation contradicts the meaning of the broader definitions of the RRS terminology. Against this background there are only a few identified interfaces with risk management:

- Sustainability has a link to product safety, hence risk (expressing responsibility for consumers).
- The strong association of resilience with system stability and recovery indicates a relationship with availability analysis (maintenance is the recoverability of a system after disturbance).
- All mean for the management to decide under uncertainty (undesired events, performance fluctuations, changing operation conditions).

For a transformation of risk management into an extended RRS management the following tasks are derivable from Fig. 3:

- Harmonisation of terminology between stakeholders and management. This applies above all to sustainability and, to a lesser extent, resilience. There is a lack of standardisation and Best practises.
- Clear allocation of time horizons for an RRS assessment, e.g. determining the risks from short-

term disruptions, from medium-term failure to achieve the required performance/resilience, and from longer-term failure to achieve sustainability goals.
- Development of applicable metrics, mainly for resilience analysis and evaluation purposes.

In summary, efforts in R&D are necessary to create an applicable framework for coordinated RRS management that build on and complement each other. A formal and structured approach as presented in this paper might be useful for the management of organisations to reach that goal.

References

Baumgartner, Rupert J, and Romana Rauter. "Strategic perspectives of corporate sustainability management to develop a sustainable organization". *Journal of Cleaner Production* 140 (2017): 81–92.

Brundtland, Gro Harlem. *Report of the World Commission on Environment and Development: Our Common Future*. un.org, visited at: Dec. 18, 2019. United Nations, 1987.

Bukowski, Lech. "Assessment of Disruption Risk Based on The Knowledge Maturity Concept". In *Proceedings of the 29th European Safety and Reliability Conference (ESREL 2019)*. Research Publishing, Singapore, 2019.

EPA. *Sustainable Manufacturing*. www.epa.gov, visited at: Dec. 16, 2019. United States Environmental Protection Agency (EPA), 2017.

Fehling-Kaschek, Mirjam, et al. "A Systematic Tabular Approach for Risk and Resilience Assessment and Improvement in the Telecommunication Industry". In *Proc. of European Safety and Reliability Conference (ESREL 2019)*, ed. by Michael Beer and Enrico Zio, 1312–1319. Research Publishing, Singapore, 2018.

Felix, R., A. Pischon, F. Riemenschneider and H. Schwerdtle. "Integrierte Managementsysteme: Ansätze zur Integration von Qualitäts-, Umwelt- & Arbeitssicherheitsmanagementsystemen". *IWÖ-Diskussionsbeitrag*, no. 41 (1997).

FSE. *The MONET 2030 indicator system*. Website. www.bfs.admin.ch, visited at: Jan. 08, 2020. Swiss Federal Statistical Office, 2020.

Hörisch, Jacob, Eduardo Ortas, Stefan Schaltegger and Igor Álvarez. "Environmental effects of sustainability management tools: An empirical analysis of large companies". *Ecological Economics* 120 (2015): 241–249.

HSE. *Reducing Risks, Protecting People*. Health and Safety Executive, 2001.

Hupp, Daniel, Tomas Hruz and Ralf Mock. "Quantifiable resilience analytics of electrical grids by simulating power flows". In *Proc. of European Safety and Reliability Conference (ESREL 2019)*. 2020.

IET. *Glossary of safety terminology*. www.theiet.org. The Institution of Engineering and Technology, Jan. 2017.

ISO-14001. *Environmental management systems. Requirements with guidance for use (BS EN ISO 14001:2015)*. International Organization for Standardization (ISO), 2015.

ISO-22313. *Security and resilience – Business continuity management systems – Guidance (ISO/DIS 22313:2019)*. International Organization for Standardization (ISO), 2019.

ISO-31000. *Risk management – Guidelines (ISO 31000:2018)*. International Organization for Standardization (ISO), 2018.

ISO-31010. *Risk management - Risk assessment techniques (SFS-EN IEC 31010:2019:en)*. International Organization for Standardization (ISO), 2019.

ISO-37151. *Smart community infrastructures – Principles and requirements for performance metrics (ISO 37151:2015)*. International Organization for Standardization (ISO), 2015.

Leksin, Alexey, Uli Barth and Ralf Mock. "The Kursk Submarine Disaster in view of Resilience Assessment (in print)". In *Proc. of European Safety and Reliability Conference (ESREL 2018)*, 1185–1192. London: Taylor & Francis Group, 2018.

Mock, Ralf, Bernhard Hulin and Alexey Leksin. "An Ontology of Risk Associated Concepts in the Context of Resilience". In *Proc. of European Safety and Reliability Conference (ESREL 2019)*, ed. by Michael Beer and Enrico Zio, 1320–1327. 2019.

Mock, Ralf, and Christian Zipper. "Embedding Resilience Assessment into Risk Management". In *Proc. of European Safety and Reliability Conference (ESREL 2017)*, 1009–1014. Taylor & Francis Group, London.

Möhle, Frank. "IT contingency planning for cyber disasters". In *Proc. of European Safety and Reliability Conference (ESREL 2015)*, ed. by Podofillini et al., 221–228. 2015.

Moldavska, Anastasiia, and Torgeir Welo. "The concept of sustainable manufacturing and its definitions: A content-analysis based literature review". *Journal of Cleaner Production* 166 (2017): 744–755.

OUP. *Definition of (a term) in English*. Oxford University Press. www.lexico.com, 2019.

Piper, Arthur. "Risks in View". *International auditor (Ia)* (Dec. 2019): 22–27.

Rüegg-Stürm, Johannes, and Simon Grand. *The St. Gallen Management Model: English translation of the fourth generation of the German text*. Vol. 1. Haupt, 2015.

Rühli, E. *Strategisches Management in schweizerischen Industrie–Unternehmungen*. 2nd Ed. Bern, Stuttgart: Haupt, 1991.

Rühli, E. , and A. Keller. *Kulturmanagement in schweizerischen Industrie–Unternehmungen*. Bern, Stuttgart: Haupt, 1991.

Rühli, E., and A. Keller. *Strukturmanagement in schweizerischen Industrie–Unternehmungen*. Bern, Stuttgart: Haupt, 1991.

Tschandl, Martin, and Alfred Posch. *Integriertes Umweltcontrolling: Von der Stoffstromanalyse zum Bewertungs- und Informationssystem*. Springer-Verlag, 2011.