BUSINESS PLAN

ISO/TC 108
Mechanical vibration, shock and condition monitoring

EXECUTIVE SUMMARY

Established in 1964, with the title "Mechanical vibration and shock" ISO/TC 108 has broadened its scope so that it now operates under the title "Mechanical vibration, shock and condition monitoring." In 2006, the TC's title and scope were updated. The current scope is:

Standardization in the fields of mechanical vibration and shock and the effects of vibration and shock on humans, machines, vehicles (air, sea, land and rail) and stationary structures, and of the condition monitoring of machines and structures, using multidisciplinary approaches.

Specific areas of current interest include the standardization of:

- terminology and nomenclature in the fields of mechanical vibration, mechanical shock, balancing and condition monitoring;
- measurement, analysis and evaluation of vibration and shock e.g. signal processing methods, structural dynamics analysis methods, transducer and vibration generator calibration methods, etc.;
- active and passive control methods for vibration and shock, e.g. balancing of machines, alignment of shafts, isolation and damping;
- evaluation of the effects of vibration and shock on humans, machines, vehicles (air, sea, land and rail), stationary structures and sensitive equipment;
- vibration and shock measuring instrumentation, e.g. transducers, vibration generators, signal conditioners, signal analysis instrumentation and signal acquisition systems;
- measurement methods, instrumentation, data acquisition, processing, presentation; analysis, diagnostics and prognostics, using all measurement variables required for the condition monitoring of machines;
- training and certification of personnel in relevant areas.

Today ISO/TC 108 and its five subcommittees maintain a catalog of 161 documents including International Standards, Technical Specifications, Technical Reports and other ISO publications which provide information and guidance to practitioners around the world. At this writing, ISO/TC 108 and its subcommittees have more than 50 work items at various stages of development and more than 40 at the preliminary stage, i.e. plans for future work.

Mechanical vibration, shock and condition monitoring affects virtually every aspect of human endeavour. This includes human health and safety, and the safe and efficient functioning of machines, vehicles (air, sea, and land) and stationary structures. Because of the fundamental nature of the subject matter, mechanical vibration, shock and condition monitoring standards impact all major sectors of the economy including the environment and the sustainability of the world's resources. Although its economic impact is impossible to measure directly, this Technical Committee's broad interests involve government, the manufacturing sector, the consumer, labour, and the public at-large.

This Technical Committee has placed an emphasis on developing standards for vocabulary, nomenclature, measurement methods and instrumentation in order to facilitate communication between vendor and end user as well as reduce uncertainty and ambiguity in contracts which rely on standards governed by the scope of this Technical Committee. These basic standards underpin the engineering standards produced by the TC 108 Subcommittees and, as such, are critical to fully understanding the ramifications of our entire portfolio of standards.

Readers of this Business Plan are encouraged to submit questions or comments on its contents or the activities of the TC and its subcommittees to Nancy Blair-DeLeon, the Secretary of ISO/TC 108 at <nblairdeleon@acousticalsociety.org> or the Chairman, Mr. Charles F. Gaumond, at <Charles.F.Gaumond.acoustics@gmail.com>.

Persons interested in participating in the work of TC 108 or any of its subcommittees should contact their country's ISO national member body.

1 INTRODUCTION

1.1 ISO technical committees and business planning

The extension of formal business planning to ISO Technical Committees (ISO/TCs) is an important measure which forms part of a major review of business. The aim is to align the ISO work programme with expressed business environment needs and trends and to allow ISO/TCs to prioritize among different projects, to identify the benefits expected from the availability of International Standards, and to ensure adequate resources for projects throughout their development.

1.2 International standardization and the role of ISO

The foremost aim of international standardization is to facilitate the exchange of goods and services through the elimination of technical barriers to trade.

Three bodies are responsible for the planning, development and adoption of International Standards: ISO (International Organization for Standardization) is responsible for all sectors excluding Electrotechnical, which is the responsibility of IEC (International Electrotechnical Commission), and most of the Telecommunications Technologies, which are largely the responsibility of ITU (International Telecommunication Union).

ISO is a legal association, the members of which are the National Standards Bodies (NSBs) of some 160 countries (organizations representing social and economic interests at the international level), supported by a Central Secretariat based in Geneva, Switzerland.

The principal deliverable of ISO is the International Standard.

An International Standard embodies the essential principles of global openness and transparency, consensus and technical coherence. These are safeguarded through its development in an ISO Technical Committee (ISO/TC), representative of all interested parties, supported by a public comment phase (the ISO Technical Enquiry). ISO and its Technical Committees are also able to offer the ISO Technical Specification (ISO/TS), the ISO Public Available Specification (ISO/PAS) and the ISO Technical Report (ISO/TR) as solutions to market needs. These ISO products represent lower levels of consensus and therefore do not have the same status as an International Standard.

ISO also offers the International Workshop Agreement (IWA) as a deliverable which aims to bridge the gap between the activities of consortia and the formal process of standardization represented by ISO and its national members. An important distinction is that the IWA is developed by ISO workshops and fora, comprising only participants with direct interest, and so it is not accorded the status of an International Standard.

2 BUSINESS ENVIRONMENT OF THE ISO/TC

2.1 Description of the Business Environment

The following political, economic, technical, regulatory, legal and social dynamics describe the business environment of the industry sector, products, materials, disciplines or practices related to the scope of ISO/TC 108, and they may significantly influence how the relevant standards development processes are conducted as well as shape the content of the resulting standards.

This technical committee is generally concerned with the effects of time-varying forces in the form of both the forces of nature and the forces created by man on complex mechanical, acoustical and biological systems, (e.g. vehicles, stationary structures, machines and humans). The forces of nature include storms giving rise to wind and wave-induced vibration and shock, earthquakes and the effects of gravity on moving systems over rough terrain. Man-made mechanical forces include those generated by machines and vehicles and range from sinusoidal to broadband to narrowband impact excitations (i.e steady-state to random transients). With this in mind, the market for standards on mechanical vibration, shock and condition monitoring can be broadly summarized as the industries and consumers of products that produce or are critically subject to these dynamic forces, as well as assets includes the evaluation of any signal and phenomenon used with condition monitoring. Government can be included in the mix either as a consumer or where public safety and the environment are issues.

Because of its fundamental role in all aspects of life, mechanical vibration, shock and condition monitoring standards impact all major sectors of the economy. Although its economic impact is impossible to measure directly, its constituencies include the government, the manufacturing sector, the consumer, labour and the public at-large. All have a major stake in the standards produced in this technical area from the basics of vocabulary and nomenclature to the applications of measurement, analysis, evaluation, diagnostics and prognostics.

For example, consider the public health and public safety issues involved in the area of human exposure to vibration and shock and the assessment of that exposure. Human activities that use machinery and vehicles both inside and outside the working environment result in exposure to potentially harmful mechanical vibration and shock. The result can be seen in increased workplace injuries and human loss of mobility and function. As a result, a need has arisen to develop standards for exposure and assessment of vibration and shock in humans in order to design condition monitoring, prognostics, mitigation and control systems that are targeted appropriately.

In summary, the International Standards produced in this Technical Committee are deeply tied to the economies of all nations in the form of trade, jobs, manufacturing and quality of life. Directly, these standards provide a framework to help improve the safe operation of and prolong the lifespan of engineering assets. Indirectly, these standards influence both the environment and the sustainability of the world's resources. Details are provided below.

ISO/TC 108 has become a horizontally integrated technical committee to better accommodate its diverse constituencies. This reflects a changing world where globalization is becoming a more dominant force in society. In the recent past, the manufacturing sector was the major constituency in the development of technical standards for mechanical vibration and shock. Now there exists a wide and growing diversity of interests between and within nations, (e.g. high versus low population density nations, high GDP versus relatively low GDP nations, predominantly natural resource and farming versus industrial economies). With this wide diversity, the impact of international technical standards in mechanical vibration, shock and especially condition monitoring is being more deeply felt by a wider segment of society than in the past. The market for standards in mechanical vibration and shock has grown significantly within the past ten years and the high rate of growth should continue for the foreseeable future as macro forces in society dictate increased awareness of the environment, public safety, sustainability of the world's resources and the globalization of trade.

Within a nation there exist competing interests so that a national consensus on a standard may not be obvious or easily determined. Public safety and the environment demand the interest of Government. Fair business practices demand the involvement of the manufacturing, Government and consumer segments of society. Each constituency brings a fresh perspective to the process of standards development and the process of the development of fair standards requires broad representation of a diversity of positions. A fair standard is written in such a way as to allow the greatest flexibility in compliance, to promote consistency with other related standards and to minimize its implementation costs. It should avoid the use of proprietary intellectual property, as that would give an unfair advantage to a select few. In developing fair technical standards, it is important to realize that the viewpoints of all national and economic constituencies are valid and, hopefully, represented in the process.

Although international standards do not carry the weight of law, they have the potential to influence the language, interpretation and direct extent of law. Technical standards are often written into contracts to monitor acceptance and performance. In other words, they have a major impact on the economy of a nation in terms of jobs, world trade, national competitiveness and GDP. The paragraphs below highlight some, but certainly not all, of the markets that are affected by the standards developed under the scope of ISO/TC 108.

<u>Machines</u>
It can be argued that machinery makes modern society run. From power generation to engines for vehicles to hand-held or hand-guided machines, to pumps, rotating and reciprocating machinery is basic to life in the twenty-first century. Manufacturers, suppliers and operators as well as the owners of machines have an interest in their performance and reliability. The condition or state of a machine is, to a great extent, determined from its vibration signature, e.g. the measurement and evaluation of the vibration of shafts and bearing housings. International Standards for the determination of the acceptability, balancing, serviceability and condition monitoring of machines are primarily being developed in SC 2 and SC 5. Balancing has been the subject of international standardization since the inception of ISO/TC 108 and remains one of its most active subjects. The balancing standards generated under the auspices of TC 108/SC 2 are among the most widely used worldwide.

<u>Vehicles (land, air and water)</u>
Motorized vehicles are pervasive in today's society. Land vehicles ranging from cars to trucks, to trains, to farm machinery, to construction vehicles are involved in moving all goods critical to society from the supplier to the user as well as in the construction of a nation's infrastructure. Ships move basic goods within countries and between continents and are especially critical to the movement of raw materials. Aircraft move smaller high-value goods and equipment over long distances. All types of vehicles transport people. As such, the ride must be safe and comfortable. The ISO/TC 108 working groups and its subcommittees are concerned with developing basic standards for dynamic design, safety and comfort of all types of land, sea and air vehicles. These standards outline the types of vibration and shock measurements, analysis procedures and evaluation criteria required to assess adequately vehicles from the viewpoint of fundamental design under dynamic loading to ride comfort to vehicular response under high impact shock. SC2 and SC5 also deliver asset management guidance and methods directly affecting cost and use of vehicles.

<u>Stationary structures</u>
TC 108 working groups and its subcommittees, primarily SC 2, are concerned with the dynamic response of a wide range of stationary structures ranging from buildings to wind turbines and sea platforms to large civil structures such as bridges, dams and tunnels. This interest extends to the assessment of basic design under dynamic loading to condition monitoring under the cumulative dynamic stress damage of service. Stationary structures can be subject to wind loads, wave action, dynamic loading produced by man (e.g. construction, road noise and vibration), and seismic activity primarily in the form of earthquakes. These time-varying forces have great dynamic range and, in single events, have produced drastic loss of life and economic dislocation of historic proportion. In addition, a need has arisen to protect our historic and cultural structures from the decay produced by the dynamic forces of modern life. This need is being addressed in the standards being produced in ISO/TC 108, e.g,SC2 and SC5 deliver asset management guidance and methods directly affecting the cost anduse of stationary structures.

<u>Human exposure to mechanical vibration and shock</u>

Dynamic environments, as well as increasing human activities using machinery both inside and outside the work environment, means human exposure to mechanical vibration, shocks and motions. Vehicles (air, land and water), machinery (e.g. used in industries and agriculture) and industrial activities (such as piling and blasting) expose people to periodic, random and transient mechanical vibration which can interfere with comfort, activities and health and safety. Depending on the vibration magnitude, frequency, time duration, direction as well as posture of the person exposed, mechanical vibration may cause health and safety risks, effects on human performance or reduction of comfort of people in buildings or in vehicles (transportation systems). ISO/TC 108/SC 4 is concerned with developing technical standards that measure, evaluate and assess human exposure to vibration and shock in various critical environments. Interested parties of the standardization work include safety engineers, labour inspectors, designers and manufacturers of machinery as well as of personal protective equipment, governmental authorities, testing laboratories, certification bodies, medical advisors/doctors, scientists and consulting engineers. These people may be involved in occupational as well as in environmental protection activities. Standards generated by ISO/TC 108/SC 4 provide the basis either to enable legislation to refer to the standards or to enable standards writers to establish specific measurement and evaluation methods which serve these legal requirements. Standards of ISO/TC 108/SC 4 establish the relationship between risks and possible hazards. This enables responsible authorities for occupational safety to set legal requirements for vibration prevention.

Additional aspects are:

- to evaluate and assess conditions at work places or at hazardous machinery,
- to assess the situation in residential areas or at workplaces in buildings when complaints caused by external vibration sources are arising,
- to provide guidelines for evaluating and assessing the vibration environment in structures, ships and offshore structures in respect to human perception and performance.

<u>Machinery condition monitoring</u>
The long-term integrity of engineering assets depends fundamentally on the quality and timing of their maintenance. Furthermore, much of the world's engineering infrastructure has exceeded or is in the process of exceeding its design life. Worldwide, maintenance costs run into countless billions of dollars per year. ISO/TC108/SC 5 aims to set standards to improve the supply-security and the effectiveness of maintenance practice through the issuance of standards in the areas of asset integrity and condition monitoring and diagnostics and prognostics.

There is a wide gulf between the stated maintenance approach and actual practice. The oldest maintenance strategy was simply to fix parts when they fail. The 1950s saw the increase of preventative maintenance. The 1970s saw the introduction of condition-based maintenance. The current cutting edge is an integrated approach that integrates state assessment techniques with predictive techniques and generally strives to optimize over both operations and maintenance. Procedures leading to the cost-effective elimination of scheduled maintenance are also emerging. These changes in maintenance practices are being accelerated in all industries. At the same time, down-sizing of companies has resulted in contracting out of many functions such as detailed system design and equipment maintenance. Consulting organizations often do not have the expertise needed to undertake the tasks needed to optimize performance. This situation puts assets at risk, often causing vast environmental damage. It is therefore crucial that the worlds' best practice in this vital area be encapsulated as international standards so that practitioners can follow appropriate guidelines and asset owners and users can avoid such catastrophic consequences.

Timely, risk-based failure prediction is an immediate problem for aircraft, defence, process, manufacturing, oil and gas, power generation and water industries. There is a crucial need for standards concerning the assessment and extension of the residual life of aging structures and machinery. Whilst safety is a primary issue, maintenance services have to deliver "smarter" outcomes to remain competitive in global markets and to minimize environmental damage. Failure prediction is also a key requirement of maintenance service providers.

Condition monitoring and diagnostics and prognostics of machines involves the use of many different technologies including vibration surveillance, process performance monitoring, thermal imaging, monitoring of acoustic emissions, ultrasonic inspection, electrical measurements such as current, voltage and phase measurements, and tribological techniques such as used-oil analysis, among others.
ISO/TC108 has therefore formed SC 5 with the title, “Condition monitoring and diagnostics and prognostics of machine systems” and the following scope:

> Standardization of the procedures, processes and equipment requirements uniquely related to the technical activity of condition monitoring and diagnostics and prognostics of machine systems in which selected physical parameters associated with an operating machine system are periodically or continuously sensed, measured and recorded for the interim purpose of reducing, analyzing, comparing and displaying the data and information so obtained and for the ultimate purpose of using this interim result to support decisions related to the operation and maintenance of the machine system.

Vibration transducers and instrumentation
Vibration transducers are the means by which vibration and shock are sensed and measured. As such, any quantitative measures of vibration and shock are fundamentally linked to the design, calibration and mounting of these sensors. ISO/TC 108/SC 3 is responsible for developing international standards detailing the calibration of vibration and shock transducers from the most basic primary calibrations conducted by national metrology laboratories to field calibrations conducted under a variety of environmental conditions. Furthermore, this Subcommittee has developed standards for the mounting of transducers as well as specification items that must be provided by the manufacturer to the user. In addition to transducers, SC 3 is responsible for developing standards for general vibration instrumentation. These standards provide the basis for conducting vibration and shock measurements and for building meaningful comparison databases used in condition monitoring of machines and structures. As such, they are fundamental to the wide spectrum of work items under the jurisdiction of ISO/TC 108. The business base for these standards includes not only transducer and instrumentation manufacturers but also users who account for the full range of constituencies listed above.

Vibration generators
Vibration generators are primarily used as test and diagnostic equipment and for environmental testing; investigation of dynamic behaviour of structural systems; system diagnostics and prognostics; calibration, oil exploration and geologic mapping of subsurface structures etc. ISO/TC 108/SC 6 has the responsibility for generating standards in this growing and fundamental area. Its scope is:

> Standardization in the field of vibration and shock generating systems, for test purposes (including environment, seismic and dynamic testing, calibration and diagnostics and prognostics) as well as auxiliary equipment and instrumentation normally associated with it.

Currently there are about 20 000 electrodynamic vibration generation systems in use for dynamic environmental testing. Of these systems, most are used to produce sinusoidal vibration environments. The rest are used to produce random vibration environments and impulse (shock) environments.

The customers can be divided into the following main categories:
transportation vehicles (automobiles, etc.) 40-50%

electronics	25-30%
government and education	5-10%
certification bodies and test laboratories	5-10%
other	10-5%

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Growth is estimated to be moderate for each category with a growth rate approximately 5 percent annually for the next three years. Total volume of all types of vibration generation systems amounts to of the order of $500 million to $1 000 million per year world-wide. Total employment for the business of the vibration test equipment can be estimated approximately at 5 000 to 7 000 people.

2.2 Quantitative Indicators of the Business Environment

The following list of quantitative indicators describes the business environment in order to provide adequate information to support actions of the ISO/TC:

The major factors which will influence the market for international standards developed under the auspices of ISO/TC 108 are:

- increasing internationalization of trade,
- increasing concern for the environment,
- increasing reliance on machinery, vehicles and stationary structures and concern for the impact of vibration and shock on human health,
- increasing impact of machinery and structural failures on the public at-large
- increasing resource sustainability
- increasing concern for public health and safety, and
- increasing consumer awareness.

The major market players whose business base will be directly influenced by standards generated under the auspices of ISO/TC 108 include:

- Airplane manufacturers, owners and operators
- Automobile industry
- Building industry for large stationary structures, buildings, bridges, tunnels, dams, wind turbines and oil platforms
- Condition monitoring and diagnostics and prognostics training and certification (assessment)
- Construction industry
- Construction vehicles and machinery
- Electrical machinery condition monitoring and diagnostics and prognostics
- Farming equipment
- Hand-held or hand guided machines industry
- Helicopter manufacturers
- Insurance industry
- Machine design community (e.g. improving performance and reducing weight)
- Machine tool manufacturers
- Machinery condition monitoring industry
- Manufacturers of vibration and shock sensors, actuators, signal conditioning instrumentation data acquisition instrumentation and signal analysis instrumentation
- Medical community
- Oil exploration and drilling
- Owners, operators and manufacturers of power generators

- Packaging industry
- Power generation
- Railroad industry
- Rotor balancing industry
- Shipbuilders, ship owners and ship operators
- Steam, gas, wind and water turbine manufacturers
- Structural condition monitoring industry
- Trucking industry, and
- Vibration and shock testing laboratories.

The major constituencies directly influenced by standards generated under the auspices of ISO/TC 108 include:

- Manufacturers and industry
- Consumers
- Government
- Academia
- Labour representatives, and
- Medical community.

3 BENEFITS EXPECTED FROM THE WORK OF ISO/TC 108

Technical standards produced under the auspices of ISO/TC 108 and its subcommittees directly impact public safety and the environment from the viewpoint of safer, less intrusive, higher quality dynamically designed vehicles, machines and structures. These standards will provide guidance as to the adequacy of basic design under the dynamic loads faced in daily operation and the effects of usage, time and the environment on the condition of machines and structures. The results of the ISO/TC 108 standards should help pave the way to:

- quieter and safer machines, buildings, civil structures, and vehicles;
- higher quality of life from lower exposure levels to vibration and shock;
- lower environmental vibration levels (e.g. saving culturally important structures);
- lower noise pollution from the radiation of sound by machines and structures;
- more reliable machines resulting from, for example, improved balancing and condition monitoring;
- increased life for machines and structures due to improved condition assessment, diagnostics and prognostics;
- improved public health and reduction in job-related injuries due to better evaluation and assessment of the effects of vibration and shock on humans;
- improved public safety due to better assessment methods for the condition of structures; and
- lower costs for maintaining infrastructure due to improved condition monitoring of structures and machines.

The photographs depicted in Figures 1 and 2 dramatically demonstrate the consequences of ignoring or poorly accounting for the dynamic forces at work in our environment. Figure 1 shows “Galloping Gertie”, a bridge over the Tacoma Narrows located in the north west of the United States as it was collapsing in 1940 from a wind-excited fundamental structural bridge resonance.

Figure 2 shows a catastrophic failure due to cracking of a rotor located in a power generation plant. Fortunately, no loss of life resulted in either incident but great economic dislocation was the result.

Although these examples show two most severe scenarios, standardization of mechanical vibration and shock measurement and evaluation involve a broad range of issues pertaining to public safety, quality of life, cultural heritage, the environment and the economy. The stakes are large and the constituencies are broad and involve consumers, industry, and Government in the protection of the public interest.

The value of standardization, in general, was validated recently in a poll of engineers. When asked to name the greatest mechanical engineering achievements of the 20th century, a survey of 1400 engineers conducted by the American Society of Mechanical Engineers placed engineering standards and codes in the top ten. This is noteworthy especially when compared with such other life-altering achievements on the list as the airplane, the automobile, Apollo spacecraft, the internet and air conditioning to name a few. To date, over 160 International Standards have been issued under the auspices of ISO/TC 108 and many more are in various stages of review.

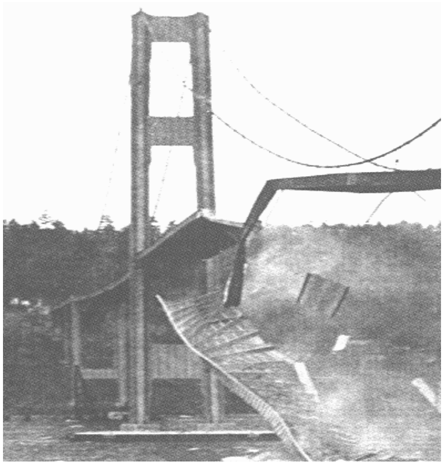

Figure 1 — Galloping Gertie The Tacoma Narrows Bridge Disaster of 1940

Figure 2 — Cracked Power Plant Rotor

4 REPRESENTATION AND PARTICIPATION IN ISO/TC 108

4.1 Countries/ISO member bodies that are P and O members of the ISO committee

Table 1 - Member bodies in ISO/TC 108 and its subcommittees

	TC 108 (20/28)	**SC 2 (22/14)**	**SC 3 (20/12)**	**SC 4 (21/11)**	**SC 5 (21/12)**	**SC 6 (7/15)**
Argentina (IRAM)	O				O	
Australia (SA)				O	P	
Austria (ASI)	O	P	P	P	O	O
Belgium (NBN)	O	P	P	O	P	O
Brazil (ABNT)	O	O	O	O	O	O
Bulgaria (BDS)	O					
Canada (SCC)	P	P	P	P	P	
China (SAC)	P	P	P	P	P	P
Croatia (HZN)	O	O				
Cuba (NC)	O					

	TC 108 (20/28)	**SC 2 (22/14)**	**SC 3 (20/12)**	**SC 4 (21/11)**	**SC 5 (21/12)**	**SC 6 (7/15)**
Czech-Rep. (UNMZ)	P	P	P	P	P	P
Denmark (DS)	P	P	P	P	P	O
Egypt (EOS)	P	P			P	
Finland (SFS)	O	O	O	O	P	O
France (AFNOR)	P	P	P	P	P	O
Germany (DIN)	P	P	P	P	P	O
Hong Kong (ITCHKSAR) Correspondent member	O	O			O	
Hungary (MSZT)	O	P	O	P		O
India (BIS)	P	P	P	P	P	P
Indonesia (BSN)	O					
Ireland (NSAI)	O	O	O	O	P	
Italy (UNI)	P	P	P	P	O	O
Japan (JISC)	P	P	P	P	P	P
Korea, D.P.R. (CSK)	O		O			
Korea, Rep. (KATS)	P	P	P	P	P	P
Malaysia (DSM)	O					
Mongolia (MASM)	O	O				
Netherlands (NEN)	O	P		O		
New Zealand (SNZ)	O	O	O		O	
Nigeria (SON)	O				O	
Norway (SN)	P	P	P	P	P	O
Pakistan (PSQCA)	O	O	O	O	O	
Poland (PKN)	O		P	P		
Portugal (IPQ)	O	O	O	O	P	O
Romania (ASRO)	O	O	O	O	O	O
Russian Fed (GOST R)	P	P	P	P	P	P
Saudi Arabia (SASO)	O	O	O			
Serbia (ISS)	O	O	O	O		
Slovakia (SUTN)	P	O	P	O	O	O
Slovenia (SIST)	P					
South Africa (SABS)	P	O	P	P	O	
Spain (AENOR)	O	P	O	P	O	O
Sweden (SIS)	P	P		P	P	
Switzerland (SNV)	P	P	P	P	P	O
Thailand (TISI)	O					
Tunisia (INNORPI)	O					
Ukraine (DSTU)	O					

	TC 108 (20/28)	SC 2 (22/14)	SC 3 (20/12)	SC 4 (21/11)	SC 5 (21/12)	SC 6 (7/15)
United Kingdom (BSI)	P	P	P	P	P	P
USA (ANSI)	P	P	P	P	P	

4.2 Analysis of the participation

The combined P- and O-membership of ISO/TC 108 and its subcommittees is 49 national member bodies. This represents an increase of 2 members since this Business Plan was last updated in 2012.

As shown in Table 1, the geographic distribution of these member bodies is diverse. The greatest number of ISO/TC 108 member countries are located in Europe (27 out of 49), with Asia represented next (11). The Americas (5), Africa (4), and Oceania (2) make up the rest of the committee.

Economic diversity is represented as well. As might be expected, developed and industrialized nations are strongly represented and make up about 51% of the members. However, emerging economies make up about 45% of the membership, according to the International Monetary Fund[1]. (Two countries, Cuba and D.P.R. Korea, are not members of the IMF and are not categorized.)

5 OBJECTIVES OF ISO/TC 108 AND STRATEGIES FOR THEIR ACHIEVEMENT

5.1 Defined objectives of ISO/TC 108

- To develop international standards on terminology and nomenclature to be used in standards generated under the auspices of ISO/TC 108.
- To develop international standards on signal processing to be used in standards generated under the auspices of ISO/TC 108.
- To develop international standards on the design, evaluation and use of vibration and shock control devices.
- To develop international standards on the measurement, data acquisition and evaluation of mechanical vibration and shock.
- To develop international standards on the evaluation and analysis of mechanical vibration and shock in stationary structures, vehicles, and machines.
- To develop international standards used in the evaluation, analysis, and assessment of the effects of vibration and shock on humans.
- To develop international standards used in the assessment of the condition of machines and structures.
- To develop international standards used in the diagnosis and prognostics assessing the condition and expected life of machines and structures.
- To develop international standards on balancing and balancing machines including terminology, tolerances, balancing procedures and safety aspects.

1 International Monetary Fund, *World Economic Outlook – Recovery Strengthens, Remains Uneven* (Washington, April 2014).

- To develop international standards used in the training and assessment of personnel involved in evaluating the condition of machines and improvements in related areas (in concert with CASCO).

5.2 Identified strategies to achieve ISO/TC 108's defined objectives

To attain the objectives outlined above, ISO/TC 108 requires the efficient use of intellectual and financial assets as well as a strong coordination between the TC and its SCs. In the 1990s the TC was reorganized. Working Groups having a scope that is broad and basic to the mission of ISO/TC 108 and those which cross SC boundaries were placed directly under ISO/TC 108. These WGs often deal with the more basic nature of the subject matter, i.e. the scientific aspects, whereas the SCs have a more engineering bent. In this way the SCs can draw on the expertise of the TC and not duplicate efforts or risk developing conflicting standards.

5.2.1 TC 108 Working Groups

Currently active work in the TC 108 Working Groups includes:
- terminology
- vibration and shock isolation
- condition assessment of structural systems from dynamic response measurements
- vibration damping materials
- measurement of vibration power flow from machines into connected support structures.

A key strategy of TC 108 is to place a high priority on the development of a series of standards that outline acceptable practices for making a mechanical vibration or shock measurement. Without these standards in place, other TC 108 engineering standards risk being severely limited or compromised since such standards are the first links in the chain of international standardization of mechanical shock and vibration. This series is built around appropriate calibration techniques for vibration and shock, appropriate signal conditioning and signal processing methods, and appropriate data acquisition methods. A series of calibration standards are being developed under the auspices of TC 108/SC 3/WG 6 which document calibration procedures ranging from primary calibration to field calibration under prescribed environmental conditions.

In addition to developing standards for the basic measurement of vibration and shock, ISO/TC 108 is also involved in metrology issues associated with the basic physics of the mechanical vibration and shock response of complex systems, e.g. measurement methods for mechanical mobility, modal analysis, structural intensity, wave-number analysis (spatial array processing) and structural damping evaluation. By emphasizing these areas, it is hoped that this committee can provide diagnostic and prognostic tools that can be consistently applied to provide meaningful and repeatable measurement results and consistent databases which are the backbone for setting performance and condition monitoring levels for acceptance and assessment purposes.

In addition to measurement practices, this technical committee periodically updates the vocabulary and symbols used in the vibration and shock and condition monitoring community. The proliferation of new technology in this area is proceeding at such a rapid rate that inconsistencies in technical language are starting to present a problem. Precise language usage is fundamental for both public law and contract compliance. It is a prerequisite for providing meaningful guidance to protect public safety, the environment. The terminology standard, ISO 2041 was updated in 2009. The WG remains available to receive input from the members in regard to new terms and definitions and improvements. Revision is anticipated on approximately a 10 year cycle.

A working group was established that deals with the measurement of dynamic system behaviour, dynamic modelling and condition assessment of stationary structures such as buildings, dams, bridges and towers. Specifically, this working group will standardize the terminology (working with

WG 1), measurement procedures and analysis methods necessary to assess the dynamic state and condition of stationary structures and to establish criteria and procedures for the timely assessment of such structural systems. Structural systems under dynamic loading and under environmental stress exhibit fatigue damage and aging (e.g. oxidation) over time which, if not properly assessed, can result in structural failure with potential danger to public safety as well as economic dislocations. These dynamic stresses can be produced by vibration and shock loading whose impact may be direct or indirect. Previous assessment methods relied heavily on inspection methods. However, in recent decades, advances in structural dynamics evaluation/diagnostics and prognostics methods have provided insights into the assessment, dynamic modelling and current condition of stationary structures that are both sensitive and quantitative. This working group will exploit these structural dynamics evaluation methods to develop standards of structural system condition assessment that can be used to protect the public safety.

Two working groups were established to standardize passive vibration and shock control devices with the aim of utilizing such devices more effectively to protect public safety and the environment, one for structural isolation methods (this working group is currently integrated into the working group on structural dynamics mentioned above) and one for structural damping using viscoelastic materials. It is anticipated that TC 108 will expand into this area with the aim of assisting the manufacturing sector and the consuming public in effectively specifying key parameters to effective dynamic design of structures.

5.2.2 ISO/TC 108 Subcommittees

In the area of machinery, SC 2 is both preparing new standards and reviewing and updating existing International Standards in the areas of:

- evaluation of machine vibration by measurements on rotating shafts and on non-rotating parts
- vibration condition monitoring of machines – in cooperation with SC 5
- evaluation of vibration of active magnetic bearing equipped rotating machinery
- evaluation of vibration of wind turbines, and vibration of hydraulic machine sets
- torsional vibration
- rotordynamics and balancing.

In the area of mechanical vibration and shock in vehicles SC 2 has adopted a strategy of developing standards in the following areas:

- guidelines for the measurement, reporting and evaluation of vibration in ships
- vibration measurements and acceptance criteria for shipboard equipment
- measurement of vibration and evaluation of their effects on buildings
- evaluation of vibration and shock in buildings with sensitive equipment
- prediction of and mitigation methods for vibration from railways
- dynamic tests and investigations on bridges and viaducts
- application of measurement results to bridge diagnosis.

In the area of vibration and shock transducers and associated instrumentation, SC 3 has adopted a strategy of developing and maintaining International Standards in the following areas:

- primary calibration methods for vibration and shock transducers
- secondary calibration methods for vibration and shock transducers
- calibration methods for vibration and shock transducers under severe environmental conditions
- human vibration meter
- transducer mounting methods for the in-situ condition monitoring of machines.

To meet the objectives in the area of human exposure and assessment to vibration and shock, SC 4 is developing and maintaining International Standards in the areas of:

- measurement and evaluation of human exposure to whole-body vibration
- measurement and evaluation of human exposure to hand-arm vibration
- measurement and analysis of vibration to which passengers and crew are exposed in railway vehicles
- laboratory methods for evaluating vehicle seat vibration
- evaluation of repetitive shocks transmitted to the whole-body
- evaluation of isolated shocks transmitted to the hand
- mechanical transmissibility of the human body in z-direction and range of idealized values to characterise seated body biodynamic response under vertical vibration exposure
- assessment of nerve dysfunction and of peripheral vascular function
- unified vocabulary for the whole technical field
- vibration reduction measures and low vibration design principles
- testing of vibration reduction equipment including personal protective equipment.

Pending the development of the state of the art, the following standard projects are envisaged to be elaborated:

- revision of frequency weighting characteristics for hand-transmitted vibration in respect to the various effects;
- guidelines on safety aspects of vibration tests and experiments with people (shocks, impacts)
- personal protective equipment, specifically against hand-arm vibration; measurement and evaluation of vibration reduction of gloves.

In the area of condition monitoring and diagnostics and prognostics SC 5 has adopted a strategy of developing and maintaining standards in the following areas:

- terminology in the field of condition monitoring and diagnostics and prognostics
- data interpretation and diagnostics and prognostics techniques
- use and selection of performance parameters
- tribology-based monitoring of machines
- prognostics
- data processing, communication and presentation
- training and assessment in the field of condition monitoring and diagnostics, prognostics and improvements of machines
- the monitoring of electrical equipment,
- infrared thermography
- acoustic techniques
- ultrasound
- condition monitoring of wind turbines – in cooperation with SC 2.

New and future work items include revision and expansion of earlier documents on diagnostics and prognostics as well as selection and set-up of performance parameters, approaches for performance diagnosis and condition monitoring of power transformers and other machines.

In the area of vibration and shock generating systems, SC 6 has adopted a strategy of developing and maintaining International Standards in the following areas:

- terminology in the field of vibration and shock generating systems;
- declaration of characteristics for systems of different types;
- test methods for verification of the characteristics to be declared;
- methods for selection of vibration and shock generating systems and their parts;

- requirements to the system characteristics and performance.

6 FACTORS AFFECTING COMPLETION AND IMPLEMENTATION OF THE ISO/TC 108 WORK PROGRAMME

The key objectives of this business plan can be met with a reasonable probability of success only if the intellectual assets currently available to the TC and SCs are fully and efficiently utilized. The key to future progress is the ability of the member bodies to staff the key working groups with knowledgeable experts from a wide range of their national constituencies so that diverse views will ensure a well-formulated technical standard fully accounting for the views of all prospective standards users. Efficiencies must be built around the coordination between the technical committee and its subcommittees. If separate agendas exist within the subcommittees that do not account for the direction set from the member bodies of the TC acting through the Chairman and the Working Groups directly under ISO/TC 108 then a significant risk exists for duplication of effort and the possible implementation of conflicting standards. In addition to the above actions, efficiencies that take advantage of new communication technologies will speed business activity within the TC and permit more effective use of scarce financial resources. A significant reduction in the flow of paper used in the conduct of business is critical to the timely delivery of standards. Since ISO/TC 108 is deeply involved with a broad area of scientific and engineering inquiry, liaisons with other ISO and IEC bodies, as well as BIPM and CASCO, are critical to the generation of quality standards with broad appeal. Standards generated under ISO/TC 108 should become normative references in the standards generated by other ISO and IEC technical committees, as well as CEN. Finally, ways to generate a more diverse participation in the process must be found that will reduce the risk of generating standards that do not adequately account for all interested constituencies.

7 STRUCTURE, CURRENT PROJECTS AND PUBLICATIONS OF ISO/TC 108

This section gives an overview of the ISO/TC's structure, scopes of the ISO/TC and the existing subcommittees and information on existing publications, and planned standardization projects, of the ISO/TC and its subcommittees.

Figure 3, which shows the organizational structure of ISO/TC 108, is given on the next page.

By following the hyperlinks given below, additional details on the structure, the work programme and the International Standards published by ISO/TC 108 will be available.

7.1 Structure of the ISO committee

7.2 Current projects of the ISO technical committee and its subcommittees

7.3 Publications of the ISO technical committee and its subcommittees

Reference information

Glossary of terms and abbreviations used in ISO/TC Business Plans
General information on the principles of ISO's technical work

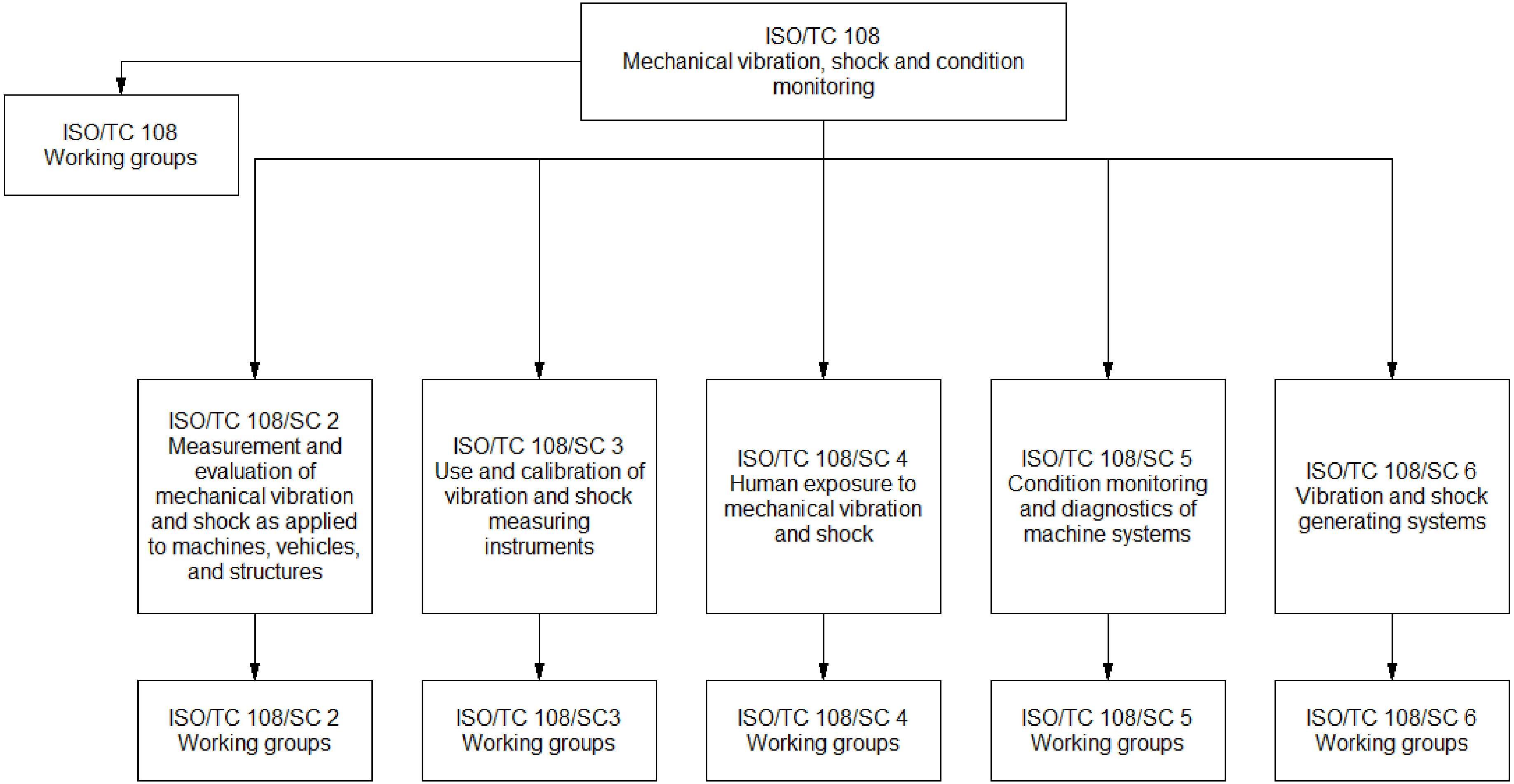

Figure 3 - Organizational structure of TC 108