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Legislative story to the extraordinary risk covers by Consorcio de Compensación de Seguros

We devote this eighteenth issue of Consorcio de Compensación de Seguros' (CCS') on-line magazine to review some current topics that we deem relevant for the insurance industry.

Summary



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Some readings for a climate crisis

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Editorial

We devote this eighteenth issue of Consorcio de Compensación de Seguros' (CCS') on-line magazine to review some current topics that we deem relevant for the insurance industry.

Firstly, and as an in-depth review, Belén Soriano, CCS Assistant Director for the Technical Area and Reinsurance, undertakes a historic overview of the rates and covers of the Extraordinary Risk Scheme since the establishment of CCS in 1954. She shows how our institution has always offering different answers to the needs of the industry, thus adapting itself to the changing circumstances of Spanish society, economy and insurance sector.



Ana Campos, building engineer specialized in habitable housing, deals in her contribution about the importance of developing simple and effective early warning systems for catastrophic events. These systems are specially needed in developing countries as they show a greater vulnerability to these events.

The contribution written by Javier Cabo, Doctor in Medicine and Cardiovascular Surgery, reviews predictive analyses, supported by artificial intelligence, to make personalized assessments of the main pathologies that might increase the morbidity and, in this way, allow for a more efficient prevention.

In the same vein, Antonio González, Head of the Customer Care Service for the Insured at CCS, refreshes the latest draft legislations by the European Commission aimed to regulate Artificial Intelligence and its use. José Antonio Badillo, Head of the CCS Madrid Regional Office and expert in civil liability, writes back in our magazine with a case law review, in this case dealing with the concept of insured interest, distinguished from that of insured risk object of the insurance contract.

In the 'reviews' section, María Nuche, Risk Management Director at CCS, discusses the last publication of the Spanish Association of Risk Management and Insurance (Agers for the Spanish), its *Manual de Riesgos Operacionales* (Handbook on Operational Risks), to which she has contributed as well. Lastly, Francisco Espejo, CCS Assistant Director for Research and International Relations, reviews several recent books dealing about the current climate crisis, the challenges society must face and the different options for not making it even worse and in favour of adaptation.

Legislative story to the extraordinary risk covers by Consorcio de Compensación de Seguros

Series 1954 - May 2023

Belén Soriano Clavero

Assistant Director, Technical Area and Reinsurance Consorcio de Compensación de Seguros

Introduction

The Consorcio de Compensación de Seguros (CCS) was established in 1954 by merging other funds together, with the aim to take charge of insurance covers for which it retains responsibility up to the present day.

Coverage of extraordinary risks is the most important of those insurance covers from the standpoint of the quantitative surcharges collected and the types of losses handled. Initially these risks were also known as catastrophic risks.



Figure 1: Busturia (Biscay), 30 August 1983. Damage caused by flooding in one of the bridges of this place. Source. EFE.

The sections that follow single out the special legislation dealing with this extraordinary or catastrophic risk insurance scheme over the course of nearly 70 years (1954-2023). The laws specifying the covers, particularly the perils covered, are listed below together with the different surcharge rates applied over time and the deductibles discounted from coverage of these risks by the CCS.

To that end, the time elapsing between 1954 and 2023 has been split into three time intervals according to the laws specifying the covers. Each of those intervals has had different schedules of surcharge rates and deductibles, and they are also detailed in the sections that follow. The three intervals are:

- 1954 1986: Ley de 16 de diciembre de 1954 sobre refundición de los Consorcios de Compensación de Riesgos Catastróficos sobre las Cosas y de Accidentes Individuales en un solo «Consorcio de Compensación de Seguros», e integrando en el mismo los Seguros Agrícolas, Forestales y Pecuarios. [Spanish Law of 16 December 1954 merging the Catastrophic Risk Property and Accident Insurance Compensation Funds into a single "Insurance Compensation Fund" also Covering Livestock, Forestry, and Agricultural Insurance].
- 1987 24 February 2004: <u>Real Decreto 2022/1986</u>, de 29 de agosto, por el que se aprueba el Reglamento de riesgos extraordinarios sobre las personas y los bienes [Spanish Royal Decree 2022/1986 enacting the Implementing Regulations concerning extraordinary risks to people and property] (the first implementing regulations specifically for the institution).
- 25 February 2004 present: <u>Real Decreto 300/2004</u>, *de 20 de febrero*, *que aprueba el Reglamento del seguro de riesgos extraordinarios* [Spanish Royal Decree 300/2004 enacting the Implementing Regulations concerning Extraordinary Risk Covers] (the second implementing regulations for this insurance fund, still in force today as amended by: (i) <u>Real Decreto 1265/2006</u>, [Spanish Royal Decree 1265/2006 amending the Implementing Regulations concerning Exceptional Risk Covers] (ii) <u>Real Decreto 1386/2011</u> [Spanish Royal Decree 1386/2011 amending the Implementing Regulations concerning Exceptional Risk Covers] and (iii) <u>Real Decreto 1060/2015</u> [Spanish Insurer and Reinsurer Management, Supervision, and Solvency Act]).

The changes in the covers (specifically, the perils covered), the surcharges, and the deductibles in each of the three above-mentioned intervals are discussed below in reference to the laws in which they were prescribed.

Also included are a brief conclusion together with Annexes I and II with the time series of surcharges and deductibles, respectively, during the interval spanning the CCS's current operating framework, namely, the period from 1 January 1987 to the present.

First time interval: 1954 – 1986

The **Law of 16 December 1954** merging the Catastrophic Risk Property and Accident Insurance Compensation Funds into a single "Insurance Compensation Fund" also Covering Livestock, Forestry, and Agricultural Insurance created the CCS, though the origins of the Fund for catastrophic non-personal injury risk covers date back to 1944 and the *Decreto de 5 de mayo de 1944 que crea el Consorcio de Compensación de Riesgos Catastróficos sobre las cosas* [Spanish Decree of 5 May 1944 creating the Catastrophic Risk Property Insurance Compensation Fund].

The <u>Decreto de 13 de abril de 1956 por el que se aprueba el Reglamento para la aplicación de la Ley de 16 de</u> <u>diciembre de 1954</u> [Decree of 13 April 1956 approving the Implementing Regulations to the Law of 16 December 1954] (**the CCS Regulations**) was published to make the above legislation maximally effective.

The basic scheme of covers, surcharge rates, and deductibles for extraordinary risks are outlined below.

Covers

By law, CCS covered unusual or extraordinary perils which were not covered under private insurance policies.

The perils covered were events of a political nature, public disorders, actions by the armed forces in peacetime, floods, volcanic eruptions, hurricanes, earthquakes, landslides, other extraordinary seismic or weather events, and more generally any extraordinary hazard not covered by regular insurance policies.

Furthermore, losses caused by hail or snow were not covered unless the events were exceptionally intense or otherwise extraordinary and had been expressly declared extraordinary by the *Dirección General de Seguros y Ahorro* [Bureau of Insurance and Savings Affairs] in a reasoned decision on the CCS's recommendation.

In addition to the perils expressly mentioned above, such other hazards as rainfall and hurricanes were also covered during this interval when associated with extremely adverse events.

Surcharge rates

The law specified a schedule of mandatory extraordinary risk surcharges as percentages of insurers' commercial premiums. These surcharge rates varied over time:

1°) Under the **Decree of 13 April 1956**, the rates ranged from 1% to 10% depending on the insurance line or type of cover:

- a. A mandatory surcharge of **10%** of the commercial premiums for the fire, theft, combined personal property fire and theft, glass breakage, comprehensive automobile, and cinema covers.
- b. A mandatory surcharge of **5%** of the commercial premiums for the insurance lines for personal accident, machinery breakdown, and land and river freight transport with supplemental dock and layover fire cover.
- c. A mandatory surcharge of **1%** of the commercial premiums for workplace accident (permanent disability and life) covers.

2°) The <u>Decreto 3161/1963</u>, <u>de 28 de noviembre</u>, [Decree of 3161/1963 of 28 November 1963 amending the CCS Implementing Regulations] set new surcharges on premiums ranging from 1% to 15% depending on the insurance line or type of cover. It took effect on 1 January 1964.

- a. **15 %** for the fire and combined personal property fire and theft covers.
- b. **10 %** for the cinema cover.
- c. **5%** for the insurance lines for theft, machinery breakdown, and land and river freight transport with supplemental dock and layover fire cover.
- d. **3%** for the insurance lines for glass breakage, personal accident (including supplemental life), and comprehensive automobile insurance where this last-mentioned line also included third-party liability cover, otherwise 5%.
- e. **1%** for workplace accident covers and on permanent disability and life insurance premiums.

3°) Lastly, the <u>Orden de 22 de mayo de 1966</u>, [Ministerial Decree of 22 May 1966 reducing certain CCS surcharges] reduced the CCS surcharges on a series of insurance covers. It took effect on 1 July 1966:

- The surcharge for the combined personal property fire and theft cover was lowered from **15% to 10%**.
- The surcharge for the theft cover was lowered from **5% to 3%**.
- The surcharge for the glass breakage, personal accident (including supplemental life), and comprehensive automobile covers was lowered from **3% to 1%**.
- The surcharge for workplace accident covers and on permanent disability and life insurance premiums was lowered from **1% to 0.25%**.

Deductibles

The relevant provision was initially worded as follows:

"The share of the loss to be defrayed by the insured is as follows:

Where the sum insured under the clauses of the policy under which the claim is made is less than 50,000 *pesetas*, the deductible will be 1% of the sum insured.

Where the sum insured is greater than 50,000 *pesetas*, the deductible will be 1% of that amount plus 0.50% on the amount over 50,000 *pesetas*.

The minimum deductible will be 500 *pesetas*, and if that amount is exceeded, the maximum deductible will be 30% of the loss. Nevertheless, where called for by the circumstances, the Consorcio may decide that not to apply the abovementioned minimum.

This deductible will not apply to losses caused by floods, inasmuch as in those cases, as provided in section 8, the indemnity paid will be only 60% or 40% of the loss assessed".

This wording was amended by <u>Decreto 3161/1963 de 28 de noviembre</u>, amending the CCS Implementing Regulations, which took effect on 1 January 1964. The previous deductible based on the sum insured was set aside and reworded as follows:

"Deductibles and underinsurance. Losses for which the claim or damage settlement is less than one thousand *pesetas* will not be entitled to compensation. The amount of the deductible will be applied to indemnities greater than that sum; nevertheless, in exceptional cases, where called for by the circumstances in question, the Consorcio may decide not to apply the above-mentioned deductible.

The Finance Ministry is authorised to raise the basic amount of the deductible where called for by the circumstances on the recommendation of the Consorcio de Compensación de Seguros".

Second time interval: 1987 – 24 February 2004

The first implementing regulations concerning extraordinary risks to people and property were enacted in 1986. These regulations contained a technical definition of the perils covered, and the CCS's insurance activities in this area were brought within the scope of the principles laid down in Ley 50/1980, de 8 de octubre, de contrato de seguro [the 1980 Spanish Insurance Contract Act].

This enumeration and definition of the perils covered supplied the requisite legal certainty for all actors involved in the extraordinary risk coverage scheme, i.e., insurers, policyholders, and the CCS itself.

The Regulations set out the overall framework for operation of the CCS in this field, and they have basically remained in effect up to the present time.

Royal Decree 2022/1986 of 29 August enacting the Implementing Regulations concerning extraordinary risks to people and property entered into force on 1 January 1987.

Covers

The Regulations prescribed that CCS covers would encompass claims for insured risks caused by:

- a. Extraordinary natural events: floods, earthquakes, volcanic eruptions, atypical cyclonic storms, and falling meteorites and other natural bodies from space.
- b. Events arising from acts of terrorism, riots, or civil turmoil.
- c. Acts or action taken by the armed forces or law enforcement agencies in peacetime.

Thus, coverage for losses caused by rainfall, hail, or snow came to an end, regardless of whether they were exceptional intense and extraordinary in nature.

Surcharge rates

Royal Decree 2022/1986 specified that surcharge rates were to be approved by Spain's Bureau of Insurance Affairs, today the Directorate-General for Insurance and Pension Funds.

Four surcharge rates were charged during this time interval:

1°) *Resolución de 28/11/1986*, [Decision of 28 November 1986] effective 1 January 1987.

The scheme for setting the extraordinary risk surcharge rates was changed from a percentage of the commercial premiums charged by insurers to a per mille amount charged on the sum insured specified in the original policy. The CCS's financial resources thus no longer depended on the insurers' business policies, and revenues were linked to the actual coverage.

The annual surcharges were initially set as follows:

- Residential and office building covers: **0.07‰** of the insured sum.
- Commercial and other simple risk covers: **0.14‰** of the insured sum.
- Industrial risk covers: **0.21‰** of the insured sum.
- Automobile covers: **fixed sum** (e.g., passenger cars: 580 pesetas = 3.49 euros).
- Personal injury covers: **0.0078‰** of the insured sum.

2°) *Resolución de 31/07/1987* [Decision of 31 July 1987] (amending the above decision) effective 12 August 1987.

This decision included civil works as a risk category with its own surcharge:

- Residential and office building covers: **0.07‰** of the insured sum.
- Commercial and other simple risk covers: **0.14‰** of the insured sum.
- Industrial risk covers: **0.21‰** of the insured sum.
- Automobile covers: fixed sum (e.g., passenger cars: 580 pesetas = 3.49 euros).
- Civil works covers: **a per mille amount** charged on the insured sum depending on the category (e.g., motorways and roads: **0.35‰**).
- Personal injury covers: **0.0078‰** of the insured sum.

3°) *Resolución de 20/05/1988*, [Decision of 20 May 1988] effective 1 August 1988.

This decision raised the applicable surcharge rates across the board:

- Residential and office building covers: **0.092‰** of the insured sum.
- Commercial and other simple risk covers: 0.18‰ of the insured sum.
- Industrial risk covers: **0.25‰** of the insured sum.
- Automobile covers: fixed sum (e.g., passenger cars: 740 pesetas = 4.45 euros).
- Civil works covers: **a per mille amount** charged on the insured sum depending on the category (e.g., motorways and roads: **0.35‰**).
- Personal injury covers: **0.0096‰** of the insured sum.

4°) Resolución de 22/07/1996, [Decision of 22 July 1996] effective 1 January 1997.

The main changes were: ending the previously extant flood surcharge for proximity to rivers, inlets, or the ocean; classifying office buildings as a separate risk category; establishing a new category of civil works, i.e., railways and pipelines; establishing a minimum surcharge for first losses; and changing the surcharge rates for certain risk categories:

- Residential building covers: **0.09‰** of the insured sum.
- Office building covers: **0.14‰** of the insured sum.
- Commercial and other simple risk covers: **0.18‰** of the insured sum.
- Industrial risk covers: **0.25‰** of the insured sum.
- Automobile covers: fixed sum (e.g., passenger cars: 900 pesetas = 5.41 euros).
- Civil works covers: **a per mille amount** charged on the insured sum depending on the category (e.g., motorways and roads: **0.34‰**).
- Personal injury covers: **0.0096‰** of the insured sum.

Deductibles

Section 9 of **Royal Decree 2022/1986** enacting the Implementing Regulations concerning extraordinary risks to people and property set out the deductibles to be borne by the insured, namely:

"a) For property insurance, 10% of the amount of the loss, not to exceed 1% of the sum insured and not to be less than 25,000 *pesetas*. The deductible will apply to each loss and to each category of risk covered for the property insured.

The Ministry of Economy and Finance is authorised to alter the minimum amount of the deductible where called for by the circumstances on the recommendation of the Consorcio de Compensación de Seguros...

b) Personal injury covers will not be subject to any deductible."

The Orden 28 de noviembre de 1986 [Decree of 28 November 1986] altered the deductibles as follows:

"The deductible to be borne by the insured in the case of extraordinary risk covers is 10% of the net amount of the indemnity to be paid for the loss, not to be less than 25,000 *pesetas* and not to exceed 1% of the sum insured. The deductible will apply to each loss and to each category of risk covered for the insured property that has been damaged.

Deductibles set in the original policy do not apply for the Consorcio de Compensación de Seguros. Personal injury covers will not be subject to any deductible."

<u>Real Decreto 354/1988 de 19 de abril</u> [Spanish Royal Decree 354/1988 amending certain sections of the Implementing Regulations concerning extraordinary risks to people and property] subsequently amended the wording as follows:

The deductible to be borne by the insured will be:

"a) For property insurance, 10% of the amount of the loss, not to be less than 25,000 *pesetas* and not to exceed 1% of the sum insured.

However, where the sum insured is less than or equal to 2,500,000 *pesetas*, there will be a unitary limit, with the deductible being set at 1% of the sum insured. Where the sum insured is greater than or equal to 1,000,000,000 *pesetas*, the deductible will be capped according to the following scale.

Sum Insured by tranche - In <i>pesetas</i>	Percentage of the loss	Absolute cap - Millions of <i>pesetas</i>
Between 1,000,000,000 and 10,000,000,000	11	12
Between 10,000,000,001 and 25,000,000,000	12	15
Between 25,000,000,001 and 50,000,000,000	13	20
Between 50,000,000,001 and 100,000,000,000	14	25
Greater than 100,000,000,000	15	30

The deductible will apply to each loss and to each category of risk covered for the property insured.

The Minister of Economy and Finance is authorised to alter the amount of the deductible specified in this section where called for by the circumstances on the recommendation of the Consorcio de Compensación de Seguros.

b) Personal injury covers will not be subject to any deductible."

Third time interval: 25 February 2004 – present

The second Implementing Regulations concerning extraordinary risk covers were enacted in 2004. They kept the overall framework for operation of the CCS and introduced significant new aspects that are discussed below.

Real Decreto 300/2004 de 20 de febrero took effect on 25 February 2004.

Covers

These Regulations added the modality of business interruption and increased coverage for atypical cyclonic storms by including losses caused by winds of 140 km/h or more and by tornados. They also altered the deductibles and the waiting period.

These Regulations have subsequently been changed by the following Royal Decrees [*Real Decreto*] amending extraordinary risk covers:

- Real Decreto 1265/2006, de 8 de noviembre included life insurance covers.
- <u>Real Decreto 1386/2011, *de 14 de octubre* lowered the wind loss cover threshold to gusting speeds of more than 120 km/h.</u>
- <u>Real Decreto 1060/2015, de 20 de noviembre</u> (Final Provision Three) established a lost profits cover for residential buildings and included a mandatory surcharge for CCS coverage of automobile third-party liability.

Surcharge rates

The surcharge rates applied are set out below:

Resolución de 28/05/2004 [Decision of 28 May 2004] effective 12 June 2004.

This Decision set out the rates for lost profits covers:

- Residential building covers: **0.09‰** of the insured sum.
- Office building covers: **0.14‰** of the insured sum.
- Commercial and other simple risk covers: **0.18‰** of the insured sum.
- Industrial risk covers: **0.25‰** of the insured sum.
- Automobile covers: fixed sum (e.g., passenger cars: 5.41 euros).
- Civil works covers: **a per mille amount** charged on the insured sum depending on the category (e.g., motorways and roads: **0.34‰**).
- Lost profits covers: (i) **0.005‰** of the insured sum for residential buildings and (ii) **0.25‰** of the insured sum for business interruption for all other risks.
- Personal injury covers: **0.0096‰** of the insured sum.

Resolución de 27/11/2006, [Decision of 27 November 2006] effective 8 December 2006.

The Decision included the rate schedule for the life insurance line and lowered the rate for personal injury covers.

- Residential building covers: **0.09‰** of the insured sum.
- Office building covers: **0.14‰** of the insured sum.
- Commercial and other simple risk covers: **0.18‰** of the insured sum.
- Industrial risk covers: **0.25‰** of the insured sum.
- Automobile covers: **fixed sum** (e.g., passenger cars: 5.41 euros).
- Civil works covers: **a per mille amount** charged on the insured sum depending on the category (e.g., motorways and roads: **0.34‰**).
- Lost profits covers: (i) **0.005‰** of the insured sum for residential buildings and (ii) **0.25‰** of the insured sum for business interruption for all other risks.
- Life and personal accident covers: **0.005‰** of the insured sum.

This Decision has been amended twice:

(i) the <u>Resolución de 12/11/2008</u> [Decision of 12 November 2008] appreciably reduced rates for property damage covers. It took effect on 21 November 2008:

- Residential building covers: **0.08‰** of the insured sum.
- Office building covers: **0.12‰** of the insured sum.
- Commercial and other simple risk covers: **0.18‰** of the insured sum.

- Industrial risk covers: 0.21‰ of the insured sum.
- Automobile covers: **fixed sum** (e.g., passenger cars: 3.50 euros).
- Civil works covers: **a per mille amount** charged on the insured sum depending on the category (e.g., motorways and roads: **0.28‰)**.
- Lost profits covers: (i) **0.005‰** of the insured sum for residential buildings and (ii) **0.25‰** of the insured sum for business interruption for all other risks.
- Life and personal accident covers: **0.005‰** of the insured sum.

(ii) the <u>Resolución de 31/05/2016</u>, [Decision of 31 May 2016] added a rate for vehicles with the compulsory Motor car Third-Party Liability (MTPL) Insurance and lowered the rate for vehicle damage covers. It took effect on 1 July 2016:

- Residential building covers: **0.08‰** of the insured sum.
- Office building covers: **0.12‰** of the insured sum.
- Commercial and other simple risk covers: **0.18‰** of the insured sum.
- Industrial risk covers: **0.21‰** of the insured sum.
- Automobile covers (MTPL and CASCO insurance): fixed sum (e.g., passenger cars: 2.10 euros).
- Civil works covers: **a per mille amount** charged on the insured sum depending on the category (e.g., motorways and roads: **0.28‰**).
- Lost profits covers: (i) **0.005‰** of the insured sum for residential buildings and (ii) **0.25‰** of the insured sum for business interruption for all other risks.
- Life and personal accident covers: **0.005‰** of the insured sum.

Resolución de 28/03/2018, [Decision of 28 March 2018] effective 1 July 2018 and currently in force.

This Decision reduced the rates for property damage, personal injury, and pecuniary loss covers.

Property damage covers: the rates for residential building and industrial covers were lowered; two risk categories, "commercial and other simple risk covers" and "industrial risk covers" were combined into an "other risk covers" category; the first loss rate schedule was simplified; seasonal insurance cover rates were eliminated (replaced by a proportional calculation based on the validity period), and a minimum surcharge of one euro cent was set.

Personal injury covers: rates were lowered, the first loss rate schedule and seasonal insurance cover rates were eliminated.

Pecuniary loss covers: rates were lowered, the seasonal insurance cover rates were eliminated, and the minimum surcharge was set at one euro cent.

- Residential building covers: **0.07‰** of the insured sum.
- Office building covers: **0.12‰** of the insured sum.
- Other risks: commercial and industrial covers and other risks: **0.18‰** of the insured sum.
- Automobile covers (MTPL and CASCO insurance): fixed sum (e.g., passenger cars: 2.10 euros).
- Civil works covers: **a per mille amount** charged on the insured sum depending on the category (e.g., motorways and roads: **0.28‰)**.
- Pecuniary loss covers: (i) **0.0035‰** of the insured sum for residential buildings and (ii) **0.18‰** of the insured sum for business interruption for all other risks.
- Life and personal accident covers: **0.003‰** of the insured sum.

Deductibles

Royal Decree 300/2004 enacted the implementing regulations for extraordinary risks and set the following deductibles:

- 1. The deductible to be borne by the insured in cases of direct losses will be:
 - a. For property damage covers, 7% of the amount of the indemnifiable damage caused by the loss. This deductible will not apply for losses involving vehicles with automobile insurance policy coverage, residential building coverage, or condominium residence coverage.
 - b. Personal injury covers will not be subject to any deductible.
- 2. For lost profits covers, the time excess or monetary deductible to be borne by the insured will be as stipulated in the policy for claims for lost profits from ordinary losses. Where various deductibles apply to the coverage of ordinary claims for lost profits, the applicable ones will be the deductibles specified for the main cover.
- 3. The Ministry of the Economy is authorised to change the amount of the deductibles specified in this section where called for by the circumstances on the recommendation of the Consorcio de Compensación de Seguros.

Royal Decree 1265/2006 amending the Implementing Regulations changed the deductibles as follows:

"Where a policy specifies a combined deductibles for property damage and lost profits, the Consorcio de Compensación de Seguros will apply the deductible of section 1 from the property damage settlement and the deductible specified in the policy for the main cover from the lost profits less the deductible applied to the property damage settlement".

Royal Decree 1060/2015 (Final Provision Three) amending the Implementing Regulations provided:

"1. For automobile damage and third-party liability, the deductible set by the Minister of Economy and Competitiveness on the recommendation of the Consorcio de Compensación de Seguros will apply.

2. Personal injury covers will not be subject to any deductible."

Orden ECC/2845/2015, de 23 de diciembre [Ministry of Economy and Competitiveness Decree 2845/2015 of 23 December 2015] contains the provisions concerning deductibles currently in force. It took effect on 1 January 2016 and reads:

"Sole section. Deductibles to be applied by the Consorcio de Compensación de Seguros in cases involving extraordinary risk covers.

1. For direct losses, the deductible to be borne by the insured in the case of property damage covers will be 7% of the amount of the indemnifiable damage caused by the loss. No deductibles will apply in the case of losses involving residential building covers, condominium residence covers, or vehicles with automobile insurance policy coverage.

- 2. In the case of miscellaneous pecuniary losses under the covers set forth in section 3 Implementing Regulations concerning Exceptional Risk Insurance Covers enacted by Royal Decree 300/2004 of 20 February 2004, the time excess or the monetary deductible to be borne by the insured will be stipulated specified in the policy for claims for lost profits from ordinary losses. Where various deductibles apply to the coverage of ordinary claims for lost profits, the applicable deductibles will be the ones specified for the main cover.
- 3. Where a policy specifies a combined deductible for property damage and lost profits, the Consorcio de Compensación de Seguros will apply the deductible of section 1 from the property damage settlement and the deductible specified in the policy for the main cover from the lost profits less the deductible applied to the property damage settlement."

Conclusion

The preceding discussion shows that the covers, rate schedules, and deductibles of the Consorcio de Compensación de Seguros have evolved in keeping with the principles of conservation and continuity to stay aligned with needs as required at all times.

The trend for the perils covered has been for them to undergo more detailed enumeration and definition and subsequently expansion, while the rates tended to increase up to 2008 and since then have tended to decrease. Deductibles have in turn tended to undergo reductions in the applicable rates, and risk categories have tended to be exempted.

Annex I

EXTRAORDINARY RISK RATES from 1987	FIRST EXTRAORDINARY RISK REGULATIONS (Royal Decree 2022/1986)				SECOND EXTRAORDINARY RISK REGULATIONS (Royal Decree 300/2004)				
Bureau Ins./Pension Fund Decision	28/11/1986	31/07/1987 with amendments	20/05/1988	22/07/1996	28/05/2004	27/11/2006	12/11/2008 with amendments	31/05/2016 with amendments	28/03/2018
Effective date	01/01/1987	12/08/1987	01/08/1988	01/01/1997	12/06/2004	08/12/2006	21/11/2008	01/07/2016	01/07/2018
Most important changes:	 first rate ‰ on insured sum instead of % on insurer's premium 	- including civil works	- increasing rates	- changing rates - cancelling flood surcharge - adding office bldgs. - minimum premium first losses - adding railways and pipelines	- including lost profits	- reducing personal injury: Accident and Life cover (new)	- reducing rates	- reducing automobile (damage & MTPL)	reducing rates - merging categories - simplifying / cancelling first table risk. Uninsured seasonal - minimum surcharge
Residences and condominiums Office buildings	0.07‰	0.07‰	0.092‰	0.09‰	0.09‰	0.09‰	0.08‰ 0.12‰	0.08‰ 0.12‰	0.07‰
Commercial and simple risks	0.14‰	0.14‰	0.18‰	0.18‰	0.18‰	0.18‰	0.18‰	0.18‰	0.19%
Industrial risks	0.21‰	0.21‰	0.25‰	0.25‰	0.25‰	0.25‰	0.21‰	0.21‰	0.10700
Motor vehicles (e.g., pass. cars)	3,49€	3,49€	4,45€	5,41 €	5,41€	5,41€	3,50€	2,10€	2,10€
Civil works (e.g., motorways and roads)		0.35‰	0.35‰	0.34‰	0.34‰	0.34‰	0.28‰	0.28‰	0.28‰
Lost profits: Residences and condominiums					0.005‰	0.005‰	0.005‰	0.005‰	0.0035‰
Other risks					0.25‰	0.25‰	0.25‰	0.25‰	0.18‰
Personal injury	0.0078‰	0.0078‰	0.0096‰	0.0096‰	0.0096‰	0.005‰	0.005‰	0.005‰	0.003‰

Surcharge rate time series:



Office buildings



Residential buildings



Commercial risks



Industrial risks









Personal Injury



Annex II

EXTRAORDINARY RISK DEDUCTIBLES from 1987	FIRST EXTRAORDINARY RISK REGULATIONS (Royal Decree 2022/1986)			SECOND EXTRAORDINARY RISK REGULATIONS (Royal Decree 300/2004)			
Legal precept:	Royal Decree 2022/1986	Decree 28/11/1986 Implementing Regulations	Royal Decree 354/1988	Royal Decree 300/2004	Royal Decree 1265/2006	Royal Decree 1060/2015 (Final Provision Three)	ECC DECREE/2845/2015
Effective date	01/01/1987	01/01/1987	with amendments 24/04/1988	21/02/2004	with amendments 23/11/2006	with amendments 01/01/2016	01/01/2016
Characteristics:	a) PROP. DAMAGE:	a) PROP. DAMAGE:	a) PROP. DAMAGE:	1. PROP. DAMAGE	1. PROP. DAMAGE	1. PROP. DAMAGE	1. PROP. DAMAGE
	Deductible =	Adds:	Adds:	Deductible =	same as previous		Deductible =
	= MIN (MAX (€150; 10% loss); 1% sum insured).	The deductible will apply to each loss and to each category of risk covered for the insured property that has been damaged.	If sum insured ≤ €15,025: Deductible = = MIN (10% loss ; 1% sum insured)	= 7% indemnifiable loss		As decided by the Ministry of the Economy on the CCS's recommendation.	= 7% indemnifiable loss
			If sum insured > €6,010.121: Deductible = = MIN (X% loss; €Y), by sum insured tranche. 11% ≤ X ≤ 15%	Exemption: - automobiles - residences and condominiums	same as previous		Exemption: automobiles - residences and condominiums
	b) PERSONAL INJURY	b) PERSONAL INJURY	b) PERSONAL INJURY	2. PERSONAL INJURY	2. PERSONAL INJURY	2. PERSONAL INJURY	2. PERSONAL INJURY
	No deductible	No deductible	No deductible	No deductible	No deductible	No deductible	No deductible
				3. LOST PROFITS	3. LOST PROFITS	3. LOST PROFITS As decided by the Ministry of	3. LOST PROFITS
				As specified in the policy for the main peril	same as previous	the Economy on the CCS's recommendation.	As specified in the policy for the main peril
					Adds: If combined deductible, in BI CCS' property damage deductible is discounted.		If combined deductible, in BI CCS' property damage deductible is discounted.

Deductible time series:



% Deductible

Digital applications: use in natural disaster management

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Introduction

New technologies are entering our daily lives every year. The use of these technologies has crystallised as a form of change that has turned society on its head in just a short span of time and will continue to do so. There will be 5.9 thousand million mobile phone users in 2025, 71% of the global population (*Mobile World Congress 2019*). This sea change is not restricted to advances in the world's most developed countries but is also transforming the developing countries. According to the United Nations, "Digital technologies have advanced more rapidly than any innovation in our history – reaching around 50 per cent of the developing world's population in only two decades and transforming societies. By enhancing connectivity, financial inclusion, access to trade and public services, technology can be a great equaliser".

The Internet is one of the main tools present in the complex system we call new technology thanks to both its impact and its wide reach. Global statistics indicate that 69% of the world's population has access to the Internet, though there are large differences from one continent to another. The share of Internet use is 89.7% of people living in Europe compared with just 39.3% of people living in Africa according to statistics from July 2022 (https://www.internetworldstats. com/stats4.htm). However, a series of measures, including the African Union's Digital Transformation Strategy, are set to expand this share in the near future. That strategy is a commitment by different African countries to develop the infrastructure needed to be able to improve precarious digital services and make advances in connectivity.

At the same time, use of new technology is not the only phenomenon that has increased in recent years. In the



Digital applications can be integrated into disaster prevention, mitigation, and management plans in places where the population knows how to use mobile devices and where secure data networks are in place.

Even though demand for the services provided by these applications is growing, most have been developed and are operated by private companies. Only a small percentage have been developed by public enterprises that offer them as a public service for information, training, and preparedness purposes in case of disaster events. Furthermore, nearly all these applications include a clause in their privacy policies entitling their operators to share user data with third parties and to sell the data entered into these applications for advertising or business purposes.

period 2000 to 2020, there were 7,348 recorded major natural disaster events that claimed 1.23 million lives (United Nations, 2020). The events that occurred most often were floods and storms, whose frequency has nearly doubled in the past 20 years. Still, the report The human cost of disasters: an overview of the last 20 years (2000-2019) points to a substantial rise in disasters of all types. These numbers are projected to continue to rise as a result of the impact of the climate crisis and the population shift into the cities, which do not have effective disaster management plans in place.

This is why it makes sense to combine the growing need for disaster prevention and management strategies with the new opportunities brought in by new technology. Despite being a growing area of study, the literature on using the Internet and other tools as resources to help us deal with extreme weather events – not to mention applications specifically designed for that purpose – is still quite sparse. That is the reason for a study into the suitability of these tools, to look at whether they could be used to prevent or report damage, and if so, how to promote their use.

Disaster vulnerability

Clearly, not all parts of the world suffer the same number of disasters. The Centre for Research on the Epidemiology of Disasters (<u>CRED</u>) reports on "events that have caused ten or more deaths, affected 100 or more people, resulted in a declaration of a state of emergency, or resulted in calls for international assistance". According to this report, from 2000-2019 Asia was the region that had the most disasters (3,068), followed by the Americas (1,756) and Africa (1,192). The countries that were most affected were China, the United States, India, the Philippines, and Indonesia (CRED). The Figure below shows the world's regions that are most likely to suffer different kinds of disasters.



Figure 1. Map of exposure to different extreme natural events. Source: By the author using data from the Internal Displacement Monitoring Center (IDMC).

Nevertheless, the fact that a given area is frequently affected by adverse natural events does not necessarily make it a vulnerable area. To borrow the Norwegian Refugee Council's definition of vulnerability: "the set of factors that increase or decrease the impact of a disaster on a community". That is, the probability that a given natural event will strike is not enough. There are also other factors such as the level of socioeconomic development, cultural circumstances, geography, and unplanned urban growth. This brings us to an important basic consideration: not all extreme natural events turn into natural disasters. A series of factors that adversely affect a community have to come together, chief among them that community's own ability to recover after an event. On that basis, the term "natural disaster" as used in this article will mean a critical natural event that has a sizeable adverse impact on the human population.

Vulnerability is the concept that is most often used when designing new disaster prevention and mitigation policies. This is not always an easy task. It is readily definable, but precisely measuring its indicators is not so easy. For example, for years the Inter-American Development Bank (IDB) has been developing a series of disaster risk indicators to be used as institutional guidelines for proposing changes to disaster preparedness and management policies. Namely:

- The index of governance and public policy (IGOPP) assesses a community's regulatory framework.
- The disaster deficit index (DDI): risk from a macroeconomic perspective.
- The local disaster index (LDI) measures the scope and damage of a small-scale disaster at the local level.
- The prevalent vulnerability index (PVI) measures risk exposure and physical susceptibility and socioeconomic fragility and resilience.
- The risk management index (RMI) quantifies institutional engagement with disaster management.

To be able to measure these indices, the IDB is currently developing new technologies for measuring vulnerability aimed at forecasting potential future economic losses and human casualties. On that basis, it is not misguided to think that mobile applications may play a fundamental role in developing these technical tools. Not just because of the programming opportunities they bring but also because they can fit in a device that large numbers of people vulnerable to a natural disaster can carry in their pocket.

Years of studying disaster risk and vulnerability have enabled us to map the countries most likely to suffer certain extreme events worldwide with a quite acceptable level of precision. These are countries that are frequently struck by disasters whose governments do not have sufficiently effective management or recovery mechanisms in place to enable people to surmount the adverse repercussions within a short span of time. In addition, we have also added an index for gauging the use and suitability of mobile applications designed to be employed in connection with natural disasters. A previous study (Análisis de aplicaciones digitales empleadas en catástrofes naturales, 2020) evaluated 60 applications for use in the pre-disaster phase to announce where and when the event is about to strike, and 12 applications for use in the post-disaster phase to gather information on the victims and their location after an event has already taken place. That study has been taken used to compare data for countries in different parts of the world that experience the most natural disasters and potential use of applications in connection with specific disasters. This will provide a new vulnerability index linked to the level of use of these technologies. Such aspects as access to mobile telephones by the population aged 15 and over, Internet connectivity, mobile network coverage, and availability of electric power have been taken into consideration.

Based on the above data set, the countries around the world where natural disasters are most likely to occur and also where access to digital technology that can be used to deal with them is limited are The Philippines, Bangladesh, Nepal, Guatemala, Costa Rica, Nicaragua, El Salvador, Honduras, Haiti, Dominican Republic, Madagascar, and Mozambique.

Earthquake vulnerability

In addition, a series of vulnerabilities to some of the most common natural events have also been considered. The methodology used has entailed correlating the regions worldwide where earthquakes most commonly strike (and where they cause the most personal injuries) with the factors regarding use of applications specifically intended for use in the event of an earthquake referred to above (Displacement Monitoring Center). This places the focus on those parts of the world where earthquakes tend to be relatively common but there are not enough digital applications available for use for purposes of prevention or mitigation.



Figure 2. Map of earthquake exposure correlated with the number of available specialised applications for use in dealing with earthquakes. Source: By the author using data from the Internal Displacement Monitoring Center (IDMC).

Figure 2 shows that there are a number of regions vulnerable to this sort of disaster. China, for instance, is a country where incentivising mobile applications could be extremely helpful, since according to the latest World Bank data, 73% of the population uses the Internet. Furthermore, the statistic for mobile telephone service subscribers is even higher, up to 122%. Singapore, with a level of mobile telephone subscribers totalling 144% and Internet penetration of 84%, is another vulnerable country that could benefit from management plans involving the use of mobile applications.

In contrast, this strategy would not be so effective in Pakistan. Even though earthquakes are frequent in the area and mobile telephone subscribers are at the level of 82%, in 2020 only 25% of the population were Internet users on any type of device.

Earthquakes often strike the west coast of South America, where the Nazca tectonic plate collides with the South American plate. However, more applications for dealing with earthquakes are available in these countries, though we also have to look at their impact to be able to suggest improvements to current applications and disclose any deficiencies they might have.

Flood vulnerability

This same method has been applied to regions where flooding commonly occurs and areas that have specific applications for that purpose.



Figure 3. Map of flood exposure correlated with the number of available specialised applications for use in dealing with floods. Source: By the author using data from the Internal Displacement Monitoring Center (IDMC).

The comparison of these data shows that the region with the most specialised flood disaster applications, Europe, is not the region with the most floods. In contrast, India, Bangladesh, Nepal, Cambodia, and certain regions in China tend to be relatively prone to flooding and do not have many applications that can be used to alert the population or to call for help if evacuation or rescue is needed. The same can be said of the lands situated in Southeast Asia and the countries on the west coast of South America, potentially vulnerable to frequent flooding from tsunamis.

Of these countries, the one that could benefit the most from using mobile applications as a disaster management tool is Chile, where 88% of the population uses the Internet and the mobile phone subscription rate is 136%. Peru is in a similar situation, with a mobile phone subscription rate of 128% and a rate of Internet use of 71%. In contrast, introducing applications would not be as effective in the Asian countries named above, at least for the time being. Though 82% of people in India are mobile phone subscribers, only 43% of the population regularly uses the Internet. The situation is similar in Bangladesh, where the rate of Internet use drops to 25%.

Hurricane vulnerability

Lastly, attention has been turned to countries' vulnerability to hurricanes. *The Comisión Nacional de Prevención de Riesgos y Atención de Emergencias* [National Commission for Risk Prevention and Emergency Response] considers a hurricane to be a meteorological phenomenon with winds faster than 200 km/h produced by the interaction between warm, moist air from the ocean and cooler air.



Figure 4. Map of hurricane exposure correlated with the number of available specialised applications for use in dealing with hurricanes. Source: By the author using data from the Internal Displacement Monitoring Center (IDMC).

The Central American region has a number of islands that are exposed to hurricanes and strong winds. There are, however, different applications specifically designed for use with this type of natural event in those countries. This is not the case for East Asia or Madagascar.

Even so, this type of event is not particularly well suited for digital management applications, because the countries where they occur most frequently do not yet have adequate tools to enable them to reach a large percentage of the population. In Haiti, for instance, only 35% of the population uses the Internet and a little over half (65%) are mobile telephone subscribers. These figures are even lower in Madagascar, with 15% frequent Internet users.

Discussion on applications

The conclusion that can be drawn is therefore that digital applications can be integrated into disaster prevention, mitigation, and management plans in places where the population knows how to use mobile devices and where secure data networks are in place. In addition to this factor, assessment of these sorts of application has disclosed a series of other factors that need to be taken into account with a view to implementing help tools.

First, many available disaster prevention and alert applications are in English. Even though English is the language most commonly used on digital media, it is the native tongue of only 5.3% of the world's population (Worlddata: the World in numbers). For everyone else, it is their second or third language, and on the whole it will be known mainly by

persons with a higher level of education in more urban settings. This situation can give rise to, one, misunderstandings technical terms little known to most people are encountered, and, two, in parallel, to discrimination, mostly of people of limited means living in more rural areas who have not been able to learn English. Additionally, these are the same people who are most vulnerable to disasters, since they live in gentrified areas without the benefit of planning.

Another aspect that needs to be considered is that even though demand for the services provided by these applications is growing, most have been developed and are operated by private companies. Only a small percentage have been developed by public enterprises that offer them as a public service for information, training, and preparedness purposes in case of disaster events. Furthermore, nearly all these applications include a clause in their privacy policies entitling their operators to share user data with third parties and to sell the data entered into these applications for advertising or business purposes. This means they can be used to serve the interests of companies that have a need to know where and when a disaster has occurred and the people who have been affected by a natural disaster event to do business and engage in sales campaigns in the affected areas.

Case study: Costa Rica

Disaster vulnerability

Costa Rica is situated in a part of the world that is highly vulnerable to natural disasters. According to the United Nations University's World Risk Index, it ranks fifth in level of exposure. This is exacerbated by a lack of urban planning, high population density, and poor land use practices that aggravate the situation further (University of Costa Rica).

It is located where the Cocos tectonic plate abuts the Caribbean plate, making it a country prone to severe seismic events, and there are also volcanoes close to population centres. In addition, its placement in the Caribbean region means that it is a multiple hazard zone that suffers frequent hydrometeorological disasters such as torrential rains, cyclones, and floods. Although hurricanes form in the Caribbean Sea, they affect the Costa Rican Pacific coast due to the circulation of winds and the Intertropical Convergence Zone movement towards the country. The "El Niño" began to have very intense effects in the first quarter of 1997. It produces heavy rains and droughts and very high temperatures on an ongoing though irregular basis. This results in falling agricultural production and economic losses and is detrimental to the quality of life of the population as a whole, which have been aggravated in recent years (ECLAC).

The most recent major disasters include Hurricane Nate with 48 fatalities in 2016, the 2009 earthquake with 25, Tropical Storm Alma with 11 fatalities in 2008, and the landslide in Las Hayas with 21.

At the present time, the *Comisión Nacional de Prevención de Riesgos y Atención de Emergencia* [National Risk Prevention and Emergency Management Board] is the organisation in charge of coordinating natural disaster preparedness. This institution has drawn up threat maps for different areas of the country that describe the specific geological and hydrometeorological hazards in each area with recommendations for mitigating their impact. This information could be included in digital applications in both written and pictorial form to reach a large segment of the population. It also has a collection of rules to be followed and documents with basic aspects for organising and operating municipal disaster risk management offices.

Costa Rica and technology

As a country Costa Rica has in recent years made great efforts to engage in technology transformation to boost development. Starting in the 1990s, it fostered stimulus programmes aimed at creating applications to develop low-

cost technologies and training projects. Nevertheless, these programmes have failed to produce ongoing strategies and publicly funded policies in line with actual needs. There has, however, been increased investment in science and technology in the last year, amounting to 2.17% of GDP in 2020 (Swissinfo).

Based on data on the use of technologies necessary to be able to implement mobile applications for use as disaster management tools in Costa Rica, 86% of the population are Internet users, and there are 8.88 million mobile telephone subscribers, equivalent to 178% of the population. This means that some people have more than one mobile telephone, either for personal or business use. Furthermore, 72% of the population regularly uses social media in their daily lives (GSMA Intelligence).

Costa Rica's *Centro Nacional de Política Económica para el Desarrollo Sostenible* [National Economic Policy Centre for Sustainable Development] conducted a study on technology use in that country and made the following findings:

- Internet use was from one to five hours daily per user.
- 78.3% used the Internet to stay informed.
- Around 21% have their own high-speed Internet connection within the device, and mobile phone penetration has increased to 152 subscribers per 100 inhabitants at the last count (2021).
- Most users were concerned about frequent connection outages and low speeds.

Integrating digital applications with disaster management plans

Costa Rica can thus be seen to have a large population of mobile telephone subscribers. People also commonly use this medium to get news and stay informed of events in the country and around the world. The population therefore has an integrated digital culture. One contributing factor to this is that 80% of the inhabitants live in urban areas (GSMA Intelligence), where technology use is more widespread and people adopt new technologies more quickly. This means that digital applications for coordinating with early warning systems and rescue services could meet with wide acceptance by the population.

Network outages are the most common user complaint. This is a problem, because if a natural disaster strikes, loss of telephone service could prevent these applications from being used. So improving the infrastructure of systems in urban areas is a necessity. The possibility of routing Internet services via satellite in rural areas where cable service cannot be assured therefore needs to be looked into. The rural population is the most vulnerable to the events considered here. Besides improving material conditions, it is also necessary to implement social training mechanisms to raise digital literacy and empower community leaders.

Lastly, Costa Rica is continuously reviewing and revising its disaster hazard management manuals. However, to date none of these revisions has included any technology tool for use by the population to coordinate with hazard warning and management systems. The specific proposal for Costa Rica would be to take all the data compiled on the threat maps and in the alert systems and enter them into a publicly developed application to be placed at the service of the public. People have grown accustomed to receiving news and messages from acquaintances or friends on a daily basis and consequently could also become used to receiving alerts about disaster events, advisories on action to be taken, information of interest, and rescue service information after the event.

Conclusions

In an ever more digital world, there can be little doubt that using tools developed to mitigate the impact of extreme events of all kinds will become more commonplace in the future. In particular, using mobile telephone applications specially designed for use in connection with disasters could serve to alert the population in the lead-up to an event, assist with communications between the people and emergency services, or report the exact location of damage in the aftermath of the event.

However, the applications cannot be used the same way all over the world. First, each country's vulnerability to different types of adverse events needs to be taken into account. There are many exposure maps showing the natural hazards that occur most often in different parts of the world. In any case, the growing trend in recent years suggests that additional countries are likely to suffer adverse impacts from growing numbers of natural disasters and that many cities are not prepared to deal with them.

Second, the status of new technologies, especially mobile telephone and Internet use, in each of these countries is also a relevant factor. Even though the world is an ever more connected place, digital illiteracy, no Internet connectivity, and even no electricity are still commonplace in many parts of the world. Moreover, these are the same regions that are the most vulnerable to disasters because of a dearth of planning and social policies and very poor living conditions.

In conclusion, digital applications may serve as a tool that institutions in charge of disaster management can put to use to establish two-way communications and mitigate adverse impacts, which will intensify in the coming decades. Nevertheless, the authorities must all be aware of the social and digital contexts in which they are operating, must buttress the areas that are most neglected, and must arrange specific solutions capable of reaching as many people as possible.

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Importance of computational modelling and risk forecasting in cardiovascular disease prevention to reduce morbidity, mortality, and health insurance claim rates

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Introducción

The different forms of computational science, whether descriptive, diagnostic, predictive, prescriptive, or preventive, are helpful in creating **predictive models** based on regression techniques like linear regression, discrete choice, time series, classification trees, Machine Learning and Data Mining methods like Gradient Boosting, Random Forest, and Bagging used to produce decision tree models, as well as plus "Bayesian Analysis" and "Artificial Neural Networks".

These tools can be used to combine learning models and improve overall results by analysing and relating large blocks of data (data mining) to extract patterns and significant trends and in that way create "decision models" based on such methods as "system dynamics", developed at MIT. Table 1.

These methods allow us to analyse and model behaviour over time in complex chaotic systems like the human body and to describe the relationships among all the decision elements and thus be able to use large numbers of variables and structural data to predict outcomes and arrive at more objective decisions with greater certainty.

In medicine generally and in cardiovascular medicine in particular, "**predictive analytics**" are extremely helpful in deciding which patients are at risk of developing certain pathological conditions or cardiovascular diseases (CVDs) and in providing a basis for decisionmaking when choosing among the various treatment and care options.



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Predictive analytics tools are important to be able to implement preventive measures to keep dangerous cardiovascular conditions, the most common cause of death worldwide, from developing and in that way reduce health insurance claim rates.



GRADIENT BOOSTING: MACHINE LEARNING TECHNIQUE USED IN REGRESSION AND CLASSIFICATION TASKS, AMONG OTHERS. IT GIVES A PREDICTION MODEL IN THE FORM OF AN ENSEMBLE OF WEAK PREDICTION MODELS, WHICH ARE TYPICALLY DECISION TREES

BAYESIAN ANALYSIS: BASED ON SUBJECTIVE PROBABILITY CONSIDERING THE KNOWLEDGE ACQUIRED PRIOR TO RESEARCH, PLUS THE EVIDENCE OBTAINED THEREOF

ARTIFICIAL NEURAL NETWORKS: IMITATING HUMAN BRAIN PERFORMANCE WITH ITS CAPACITY TO LEARN OR ADAPT, TO ORGANISE OR GENERALISE DATA

RANDOM FOREST: TECHNIQUE TO BUILD AN ENSEMBLE OF DECISION TREES WITH THE IDEA THAT A COMBINATION OF LEARNING MODELS IMPROVES THE OVERALL OUTCOME

Table 1. Predictive analytics methods used to generate decision models. Source: By the autor.

Claim rates due to cardiovascular diseases

Cardiovascular diseases have far-reaching social (mortality and morbidity statistics) and economic (public healthcare costs) impact. Even so, their great importance and social repercussions notwithstanding, most citizens in the European Union (EU) are not yet mindful of the potentially fatal impact of heart disease on the populace.

A recent survey conducted by Daichi Sankyo, a Japanese pharmaceutical company, in the framework of the *We Care for Every Heartbeat* campaign, in five European countries (United Kingdom, Italy, Germany, Spain, and the Netherlands) assessed the level of awareness and understanding of cardiovascular diseases and their impact on society by the general population. The survey results show that on average only 24% of respondents knew that cardiovascular disease was the leading cause of death in Europe. This figure fell to 19% in Spain, the country in this study with the least awareness of the potential impact of heart disease on mortality.

Mortality worldwide

According to data reported by the World Health Organization (WHO), the ten main causes of mortality worldwide in the most recent period on record, 2019 and 2020, were, in order of rank:

CVDs accounted for the top two, first myocardial ischaemia (heart attack), followed by neurovascular disorders (ischaemic or haemorrhagic stroke). Third was lung disease, first chronic obstructive lung disease (COPD), followed by respiratory infections; neonatal mortality; tracheal, bronchial, and lung cancers; Alzheimer's disease and other dementias; digestive disorders producing diarrhoea; diabetes mellitus; and ranked tenth, kidney disease (Figure 1).



Figure 1. Leading causes of death worldwide. Source: World Health Organization.

The 10 main causes of death accounted for 55% of the 55.4 million deaths worldwide in 2019. These leading causes of death worldwide have been divided into three main categories based on the total number of lives lost: cardiovascular diseases (ischaemic heart disease, stroke), respiratory diseases (chronic obstructive lung disease, lower respiratory tract infections), and neonatal conditions including asphyxia and birth trauma, sepsis and neonatal infections, and preterm birth complications. Causes of death can be grouped into three categories, communicable diseases (infectious and parasitic diseases, maternal, perinatal, and nutritional conditions), noncommunicable diseases (chronic), and injuries.

Worldwide, in 2019 7 of the 10 main causes of death were noncommunicable diseases. These 7 causes accounted for 44% of all deaths and 80% of all deaths from the 10 leading causes. All noncommunicable diseases together accounted for 74% of deaths globally in 2019. Ischaemic heart disease is the main cause of death, accounting for 16% of total deaths. This disease has been responsible for the largest increase in deaths since the year 2000, rising from 2 million deaths in 2000 to 8.9 million deaths in 2019. Stroke and chronic obstructive lung disease are the second and third leading causes of death and account for approximately 11% and 6% of all deaths, respectively.

Lower respiratory tract infections are still the deadliest communicable disease in the world and are the fourth leading cause of death. However, the number of deaths has gone down considerably, taking 2.6 million lives in 2019, 460,000 fewer than in 2000. Neonatal conditions rank fifth. Deaths from neonatal causes are one of the categories in which deaths have fallen the most in absolute terms over the past two decades. These conditions took the lives of 2 million newborns and infants in 2019, that is, 1.2 million fewer than in 2000.

Deaths from noncommunicable diseases are on the rise. Deaths from tracheal, bronchial, and lung cancers have risen from 1.2 million to 1.8 million and now rank sixth among the leading causes of death. Alzheimer's disease and other forms of dementia were the seventh leading cause of death in 2019 and disproportionately affect women. Women make up 65% of deaths from Alzheimer's and other forms of dementia. Diarrhoeal diseases have

undergone one of the largest declines in number of deaths, dropping from 2.6 million deaths in 2000 to 1.5 million deaths in 2019 worldwide. Diabetes has turned into one of the 10 leading causes of death following an appreciable percentage increase of 70% since the year 2000. Of the 10 main causes of death, diabetes is also behind the largest increase in deaths in men, rising by 80% since 2000.

Other diseases that were among the 10 leading causes of death in 2000 are no longer on the list. HIV/AIDS is one of these. Deaths from HIV/AIDS have fallen by 51% in the last 20 years, and this cause has dropped from being the eighth-ranked cause worldwide in 2000 to nineteenth place in 2019. Deaths from kidney disease have increased, and this cause has risen from the 13th cause of death to tenth worldwide. Deaths from this cause rose from 813,000 people in 2000 to 1.3 million in 2019.

Main causes of death by income group

The World Bank classifies the world's economies into four income groups based on gross national income – low, lower-middle, upper-middle, and high. Breaking down reported mortality by country shows that the causes of death differ somewhat according to countries' level of development and GDP (Figure 2).



Figure 2. Country ranking by income level (2021). Source: World Bank.

Mortality in low-GDP, low-income, less socially and economically developed countries

The main causes of death in low-GDP, low-income, less socially and economically developed countries are neonatal mortality ranking first, followed by respiratory infections in second place, and then the CVDs ischaemic heart disease ranking third and stroke ranking fourth. Next in order of frequency come diarrhoeal diseases, malaria, traffic accidents, tuberculosis, HIV/AIDS, and cirrhosis of the liver (Figure 3).



Leading causes of death in low-income countries

Figure 3. Main causes of death in low-income countries. Source: World Health Organization.

According to WHO statistics, people living in low-income countries are far more likely to die from a communicable disease than from a noncommunicable disease. Despite a global decline in communicable diseases, they still account for 6 of the top 10 causes of death in low-income countries. Malaria, tuberculosis, and HIV/AIDS continue in the top 10 leading causes of death. Nevertheless, all three are declining considerably. Among the top 10 causes of death in this group, HIV/AIDS has decreased the most, with 59% fewer deaths in 2019 than in 2000, or 161,000 and 395,000 people, respectively. Diarrhoeal diseases are more significant as a cause of death in low-income countries, ranking among the five main causes of death in this income group. Still, diarrhoeal diseases in low-income countries are decreasing, with the second largest decline in fatalities among the top 10 causes (231,000 fewer deaths). Deaths from chronic obstructive pulmonary disease are especially infrequent in low-income countries compared to the countries in the other income groups. It is not one of the 10 leading causes of death in low-income countries, yet it ranks as one of the top 5 causes in the countries in all other income groups.

Lower-middle-income countries have the most disparate main causes of death: five noncommunicable, four communicable diseases, and injuries. Diabetes is a growing cause of death in this income group, rising from the 15th to the 9th leading cause of death. The number of deaths from this disease have nearly doubled since 2000.

Diarrhoeal diseases remain a significant challenge as one of the 10 leading causes of death in the countries in this income group. However, this category of diseases has experienced the biggest decrease in absolute numbers of deaths, from 1.9 million to 1.1 million between 2000 and 2019. The biggest increase in deaths in absolute numbers has been for ischaemic heart disease, with deaths rising by more than 1 million to 3.1 million since 2000. Among the 10 main causes of death, HIV/AIDS has dropped the most in the ranking since 2000, falling from 8th to 15th.

Thus, CVDs are now clearly the two main causes of death in the lower-middle-income countries. Myocardial ischaemia (heart attack) is the leading cause of death and stroke the second leading cause, followed by neonatal

mortality, lung diseases (COPD and respiratory infections), diarrhoeal diseases, tuberculosis, cirrhosis of the liver, diabetes mellitus, and traffic accidents (Figure 4).

Leading causes of death in lower-middle-income countries
○ 2000 ● 2019
1. Ischaemic heart disease
2. Stroke
3. Neonatal conditions
4. Chronic obstructive pulmonary disease
5. Lower respiratory infections
6. Diarrhoeal diseases
7. Tuberculosis
8. Cirrhosis of the liver
9. Diabetes mellitus
10. Road injury
0 1 2 3 4 Number of deaths (in millions)
Noncommunicable Communicable Injuries

Figura 4. Causas principales de mortalidad en los países con ingresos medios bajos. Fuente: Organización Mundial de la Salud.

Mortality in upper-middle-income countries

According to WHO data, in the upper-middle-income countries there has been a notable rise in deaths from lung cancer, increasing by 411,000, more than twice the increase in deaths in all the other three income group countries combined. Stomach cancer features highly in upper-middle-income countries compared to the other country income groups. These countries are the only group in which this disease is one of the 10 main causes of death.

One of the biggest decreases in deaths in absolute terms is from chronic obstructive pulmonary disease, falling by some 264,000, to 1.3 million deaths. However, deaths from ischaemic heart disease have grown by more than 1.2 million, the largest increase in deaths from this cause, in absolute numbers, in any country income group. There is only one communicable disease (lower respiratory tract infections) among the 10 leading causes of death in upper-middle-income countries. At the same time, there has been a 31% drop in deaths from suicide since 2000 in the countries in this income group, falling to 234,000 deaths in 2019.

In short, cardiovascular diseases, i.e., myocardial ischaemia (heart attack), stroke, and hypertensive heart disease, rank first, second, and seventh as causes of death in the upper-middle-income countries. Respiratory diseases (COPD, tracheal, bronchial, and lung cancers, and respiratory infections) rank third, fourth, and fifth as causes of death, followed by diabetes, hypertensive heart disease, Alzheimer's disease and dementias, stomach cancer, and traffic accidents. Neonatal mortality and diarrhoeal diseases have disappeared as main causes of death in these countries (Figure 5).

Leading causes of death in upper-middle-income countries
○ 2000 ● 2019
1. Ischaemic heart disease
2. Stroke
3. Chronic obstructive pulmonary disease
4. Trachea, bronchus, lung cancers
5. Lower respiratory infections
6. Diabetes mellitus
7. Hypertensive heart disease
8. Alzheimer's disease and other dementias
9. Stomach cancer
10. Road injury
0 1 2 3 4 Number of deaths (in millions)
Noncommunicable Communicable Injuries

Figure 5. Main causes of death in upper-middleincome countries. Source: World Health Organization.

Mortality in high-income countries

Deaths from all but 2 of the 10 main causes of death have been rising in high-income countries. Ischaemic heart disease and stroke are the only causes of death in the top 10 for which the total numbers have gone down between 2000 and 2019, by 16% (or 327,000 deaths) and by 21% (or 205,000 deaths) respectively. High-income countries are the only income group in which deaths from these two diseases have been falling.

In any case, ischaemic heart disease and stroke are still among the three main causes of death in the countries in this income group, with a combined total of over 2.5 million fatalities in 2019. In addition, deaths from hypertensive heart disease are on the rise. Mirroring a worldwide trend, this disease has climbed from being the 18th leading cause of death to being the 9th. Deaths from Alzheimer's disease and other dementias have increased, overtaking stroke to become the second leading cause of death in high-income countries, where these conditions were responsible for the deaths of 814,000 people in 2019. And as in the case of upper-middle-income countries, there is only one communicable disease among the 10 main causes of death, lower respiratory tract infections.

To sum up, in highly developed, high-income countries, the top three main causes of death are, first, CVD (heart attack), second, Alzheimer's and other dementias, and third, another CVD, stroke. Ranked fourth through sixth are respiratory diseases, e.g., tracheal, bronchial, and lung cancers, COPD, and respiratory infections. They are followed by colorectal cancer in seventh place, kidney disease in eighth place, with another cardiovascular disease condition, hypertensive heart disease, ranked ninth, and finally diabetes ranked tenth (Figure 6).
1. Ischaemic he	art disease			
2. Alzheimer's d	isease and other dem	entias	0	
3. Stroke				
4. Trachea, bror	chus, lung cancers			
5. Chronic obstr	uctive pulmonary dise	ease		
6. Lower respira	tory infections			
7. Colon and rec	tum cancers			
8. Kidney diseas	es			
9. Hypertensive	heart disease			
10. Diabetes me	llitus			
)	1		2	3
	Number of de	aths (in mill	ions)	

. . . .

Figure 6. Main causes of death in high-income countries. Source: World Health Organization.

It should be noted that mortality from cardiovascular disease, the main cause of death worldwide, can be seen to have increased by 25.1% overall. This increase has been most pronounced in the countries of Southeast Asia (56.2%), in the countries of the eastern Mediterranean region (54.1%), in the countries of the western Pacific (47.4%), in the African countries (31.4%), and in the countries of the Americas (14.9%). In contrast, a 14% decrease in reported mortality has been observed in Europe (Figure 7).



Figure 7. Increased mortality from cardiovascular disease. 2019-2020. Source: World Health Organization.

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Therefore, ischaemic heart disease is the leading cause of death worldwide, accounting for 16% of all fatalities globally since the year 2000, with deaths from this cause growing the most, rising by over 2 million, to 8.9 million deaths in 2019.

Mortality in Europe

According to Eurostat, the main causes of death in all European countries are cardiovascular disease, ischaemic heart disease (heart attack), and stroke, followed by cancer, especially colorectal and lung cancer (Table 2 and Figure 8).

	Total					Females						
	Circulatory disease	Heart disease (1)	Cancer (²)	Lung cancer (³)	Colorectal cancer	Respiratory diseases	Diseases of the nervous	Transport accidents	Suicide	Breast cancer	Cancer of the cervix	Cancer of the uterus
E11-28 (4)	373.6	126.3	261.5	54.4	30.5	78.3	system 38.6	5.8	11.3	32.6	3.0	6.6
Belgium	281.0	72.4	252.6	61.6	26.1	95.7	46.5	6.7	17.3	37.0	2.7	6.4
Bulgaria	1 131 0	195.4	202,0	45.5	34.9	58.1	15.3	9.0	9.9	32.6	87	9.0
Czech Republic	615.2	333.1	284.6	53 1	37.9	73.4	30.8	7.8	14.4	29.1	57	8.0
Denmark	256.6	81.0	300.6	71 7	35.2	115.7	42.9	4.0	11.9	39.7	36	6.1
Germany	403 5	142.8	253.2	51.0	29.0	68.0	29.6	4.6	11.9	35.6	32	4.9
Estonia	699.6	295.5	299.4	55.3	36.0	43.8	21.8	7.5	18.3	31.8	8.6	5.9
Ireland	309.9	147.5	288.3	61.5	32.4	125.9	48.7	4.0	11.0	41.2	5.0	7.8
Greece	381.4	103.0	249.3	61.9	23.3	108.1	20.9	8.6	5.0	31.0	2.3	5.9
Spain	245.0	68.2	232.7	47.8	33.6	91.7	48.5	4.3	8.2	23.7	2.3	6.2
France	202.9	49.3	245.4	50.1	26.1	52.0	50.2	5.1	14.1	32.9	2.2	7.4
Croatia	678.6	306,5	336,4	65.2	51,0	59.7	21.3	8,9	16.8	44,5	5.5	11.1
Italy	310,1	98,3	246,6	49,4	27.0	58,3	34,3	5,6	6.3	31,7	1.3	6,5
Cyprus	351.8	108,7	201.0	37.2	16,7	86.2	26,8	6,5	4.5	26,6	1.5	9,2
Latvia	882.7	442,7	299,3	46,9	34,2	35,9	15,6	12,4	19.0	34,6	9,5	9,5
Lithuania	848,8	564,4	276,2	46,1	32,1	42,1	20,8	10,7	31,5	28,5	10,4	8,4
Luxembourg	296,9	80,3	260,7	59,6	25,5	63,8	38,0	6,0	13,4	35,6	3,2	6,3
Hungary	761,5	390,6	348,1	89,8	55,0	78,6	19,9	8,1	19,4	37,9	7,6	8,2
Malta	372,4	202,8	233,5	43,2	28,3	96,6	21,0	2,5	8,3	35,1	1,8	12,7
Netherlands	271,7	62,4	282,2	66,7	32,9	74,1	48,3	4,1	11,1	35,2	2,4	5,9
Austria	418,1	179,1	249,3	47,5	26,4	46,6	32,6	5,8	15,3	32,4	3,4	5,5
Poland	591,4	129,1	292,3	69,2	36,0	69,1	16,5	10,3	15,5	31,0	8,3	8,0
Portugal	305,8	69,6	242,1	36,4	35,0	116,7	32,8	7,8	11,3	26,7	3,5	6,4
Romania	951,3	320,3	273,2	54,2	32,4	78,4	21,0	12,3	11,4	32,1	16,4	6,0
Slovenia	451,3	102,8	299,9	58,6	38,4	66,3	21,1	6,7	18,9	33,5	4,4	9,3
Slovakia	654,6	388,8	324,1	50,0	49,2	74,9	29,5	8,5	10,8	35,8	8,7	9,9
Finland	378,8	199,2	218,6	39,0	22,6	34,4	155,0	5,7	14,6	26,6	1,8	6,1
Sweden	338,3	131,2	234,8	38,7	29,2	58,1	42,6	3,4	12,1	27,0	2,6	6,3
United Kingdom	264,9	118,4	278,4	61,4	27,7	130,9	47,6	2,8	7,1	34,7	2,8	6,7
Liechtenstein	296,4	73,7	203,0	31,3	6,8	89,8	67,6	10,3	10,2	41,0	:	9,9
Norway	272,6	95,7	252,5	50,5	36,4	88,4	45,4	4,0	7,3	27,2	2,7	7,2
Switzerland	280,0	97,8	219,6	42,1	22,8	51,3	44,5	3,6	12,8	31,1	1,4	5,1
Serbia	931,6	159,5	298,3	69,4	37,2	79,7	27,3	7,6	15,9	41,9	10,4	8,0
Turkey (⁵)	1	:	1	1	1	:	1	:	:	1	2,2	4,2

Table 2. Main causes of death in Europe by country. Source: Eurostat.

Circulatory diseases like ischaemic heart disease (heart attack) and cerebrovascular conditions like stroke are the most common causes of death. Ischaemic heart disease was responsible for 126 deaths per 100,000 inhabitants in the EU based on 2014 data.



Figure 8. Main causes of death in Europe. Source: Eurostat.

There are nearly **4 million deaths from cardiovascular disease** (CVD) in Europe per year, i.e., 10,000 deaths daily. Prevalence is therefore extremely high. Most recently, more than 60 million people were living with CVD in the EU in 2020, and nearly 13 million new cases are diagnosed each year. Based on longevity and life expectancy projections, incidence is expected to increase in the coming years. Ischaemic heart disease alone was responsible for 126 deaths per 100,000 inhabitants in the EU and for 16% of deaths worldwide.

Mortality in Spain

The standardised average mortality rate from heart disease in Spain in 2020 was 219.4 deaths per 100,000 inhabitants. It was the most frequent cause of death at 24.30%, followed by cancer at 22.80%. It is noteworthy that the mortality rate in women (53.32%) was higher than the rate recorded for men (46.67%) (Figure 9).



In absolute numbers of cases per year, deaths from CVD in 2020 (119,853 deaths) increased compared to deaths from that same cause in 2019 (116,215 deaths), a 2.4% rise. Again, it should be noted that according to the data, nearly 8,000 more women than men die from CVD in Spain each year (Figure 10).



Figure 10. Deaths from CVD in Spain. Source: Sociedad Española de Cardiología and Instituto Nacional de Estadística.

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Circulatory diseases remain the leading cause of death in Spain. In 2020 119,853 people died from cardiovascular causes, 24.3% of all deaths. At 112,741 deaths (22.8%), tumours were the second cause of death, and infectious diseases, including COVID-19, were the third cause of death, at 80,796 fatalities (16.4%).

Based on data from Spain's regions, the standardised average mortality rate from CVD in 2020 was 219.4 deaths per 100,000 inhabitants. The Autonomous Cities, Ceuta at 321.6 deaths per 100,000 inhabitants and Melilla at 298.5 deaths per 100,000 inhabitants, had the highest rates in the entire country. By Autonomous Community, Andalusia (282.3 deaths), Murcia (260.9 deaths), and Extremadura (245.4 deaths) were the regions with the most deaths from circulatory diseases. Four other regions (Valencia, Asturias, the Canary Islands, and Castilla-La Mancha) had standardised mortality rates from cardiovascular causes that were higher than average. A total of 10 Autonomous Communities had standardised mortality rates from heart disease that were lower than average. Navarre (172.8), Madrid (173.2), and the Basque Country (186.3) were the regions with the lowest death rates from circulatory disease in Spain (Figure 11).



Figure 11. Standardised average mortality rates from CVD in Spain in 2020 by Autonomous Community. Source: Instituto Nacional de Estadística.

The number of deaths from hypertensive heart disease in Spain in 2020 (14,271) rose compared with the previous year (11,854). Mortality from this cause has been growing non-stop over the past 15 years, to the point where today the number of deaths from this cause doubles the number of 2006. Mortality from stroke has decreased (Figure 12).

However, in connection with this decrease in mortality from cerebrovascular causes, the 70th annual meeting of the Sociedad Española de Neurología [*Spanish Neurology Society*] said that the number of cases of stroke and mortality caused by stroke are set to grow by 35% over the next 15 years.

At the present time, there are 120,000 new cases of stroke and 27,000 people die from this cause in Spain each year. It is the leading cause of death in women, the third leading cause of death in men, and the main cause of acquired disability in adults. In Spain two of every three people who have suffered a stroke are older than 65 years of age, but the number of cases among people aged between 20 and 64 has risen by 25% in the past 20 years. The most important aspect to bear in mind is that at least 80% of strokes could be avoided by taking appropriate preventive measures to address the risk factors associated with this disease, e.g., high blood pressure, diabetes mellitus, smoking, and hyperlipidaemia, along with related lifestyle factors like obesity, improper eating habits and nutrition, and physical inactivity. These risk factors are also associated with mortality from cardiovascular ischaemia (heart attack) and non-ischaemic heart disease (arrhythmias and sudden death) (Figure 12).



Figure 12. Time trend for causes of death in Spain from 2003 to 2020. Source: Instituto Nacional de Estadística.



Figure 13. Factors for heightened risk of cardiovascular heart disease and associated death. Source: Instituto Nacional de Estadística and Sociedad Española de Cardiología.

Predictive models to reduce claim rates

Two of the main cardiovascular risk factors that trigger ischaemic heart disease and ischaemic stroke are elevated cholesterol, more specifically LDL (low-density lipoprotein) **cholesterol**, and **hypertension**. They can be readily altered by changes in eating habits and lifestyle, in certain cases in association with treatment with statins and/or vasopressors or beta blockers.

Worldwide, the American Heart Association, the European Society of Cardiology, and other international scientific groups have developed consensus guidelines for preventive action for both ischaemic heart disease (heart attack) and cerebral ischaemia (ischaemic stroke). One of these is the **"Framingham risk score"**, from the United States, used to assess the probability that coronary morbidity or mortality (angina, heart attack, sudden death) will occur in the next 10 years based on age, blood pressure, and cholesterol level.

Additional tools connected with cardiovascular risk include the **"SCORE chart"** in Europe for calculating mortality from CVD (coronary and cerebrovascular); the **"Reynolds risk score"**, also from the United States, for assessing cardiovascular risk (cardiovascular mortality, heart attack, revascularisation, and stroke) based on age, blood pressure, cholesterol level, diabetes, and C-reactive protein; the **"QRISK calculator"** from the United Kingdom

for calculating the probability of CVD morbidity and mortality (coronary and cerebrovascular) based on age, blood pressure, cholesterol level, and body mass index.

Two further calculators are the **"ASSIGN score"** from Scotland for assessing CVD mortality and coronary morbidity (hospitalisation and revascularisation) based on age, blood pressure, and cholesterol level; and the **"PROCAM study"** in Germany for calculating coronary morbidity and mortality (angina, heart attack, sudden death) based on age, blood pressure, cholesterol level, diabetes, and triacylglycerols.

Lastly, there is the **"CHA₂DS₂-VASc score"**, prediction rules for stroke prevention in patients with atrial fibrillation using oral anticoagulation therapy (Table 3).

The most commonly used risk stratification algorithms

Scale	No. of variables	Outcomes considered	Derivation cohort	Validation cohort
Framingham ^₄	1-5	А	United States, ages 30-62	Various
SCORE ⁵	1-5,9	В	Europe, ages 45-64	Europe
ASSIGN ⁶	1,2,4,5,7,8	С	Scotland, ages 30-74	Scotland
Reynolds ^{7,8}	1-7,10	D	United States, ages 45-80	United States
QRISK ⁹	1-5,7,8,11	E	United Kingdom, ages 35-74	United Kingdom
PROCAM ¹⁰	1-7,12	A	Germany (men), ages 35-74	Germany

Risk factors considered:

- 1, age and sex;
- 2, systolic blood pressure;
- 3, smoking;
- 4, total cholesterol (PROCAM, LDL cholesterol);
- 5, HDL cholesterol;
- 6, diabetes mellitus (Reynolds risk score,
- glycohemoglobin);
- 7, family history of early onset CVD;
- 8, social deprivation;
- 9, prevalence of CVD in the population;
- 10, C-reactive protein;
- 11, body mass index;
- 12, triacylglycerols.

Outcomes considered:

A, coronary morbidity and mortality (angina, heart attack, sudden death);
B, CVD mortality (coronary and cerebrovascular);
C, CVD mortality and coronary morbidity (hospitalisation and revascularisation);
D, cardiovascular morbidity and mortality (cardiovascular morbidity, heart attack, revascularisation, and stroke/TIA);
E, CVD morbidity and mortality (coronary and cerebrovascular);

Table 3. Most widely used risk stratification algorithms worldwide.

Source: Revista Española de Cardiología [Spanish Journal of Cardiology]; Suppl. 2012; 12(C):8-11.

The most widely used stratification algorithms include the **Framingham risk score**, developed based on a cohort of persons aged 30 to 62 in the United States and validated worldwide. It is used to assess the probability of coronary morbidity and mortality (angina, heart attack, sudden death) in the next 10 years based on age, both LDL and HDL cholesterol levels, blood pressure, presence or absence of diabetes mellitus, and smoking habit (Figure 14).



Figure 14. Exemplification of the Framingham risk score. Source: Circulation. 1998; 97:1837.1847.

Another widely used algorithm in Europe, and hence in Spain, is the **SCORE chart**, developed based on a cohort of Europeans between the ages of 45 and 64 and validated on a broad sample cohort of Europeans. It assesses the risk of mortality from CVD (coronary and cerebrovascular) by applying 10-year cardiovascular mortality hazard ratios based on a series of variables including age, sex, systolic blood pressure, smoking habit, cholesterol (LDL and HDL), and prevalence of CVD in the population (Figure 15).





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Predictive analysis of atrial fibrillation (AF)

The **CHA₂DS₂-VASc score** is another popular scale used in the interest of preventing cardiovascular disease, more specifically cerebrovascular causes of stroke in patients with arrhythmia (atrial fibrillation: AF). AF is the most common arrhythmia that has clinical repercussions. It is responsible for the most visits to emergency rooms and causes the most days spent in hospital. It is associated with increased morbidity (particularly stroke and heart failure) and mortality. AF grows more prevalent in both men and women with age. AF is increasingly being related not to the presence of existing heart disease but to a combination of cardiovascular risk factors closely linked to lifestyle, such as obesity, sedentary habits, diabetes mellitus, and sleep apnoea. AF is more prevalent in the developed countries, where an ageing population is combined with a sedentary lifestyle and obesity, than in the less developed countries. It affects 1-2% of the general population and is projected to increase in the coming years. Forecasts suggest that prevalence will at least double over the next 50 years.

According to studies in Europe, prevalence is estimated at between 0.2 and 2% of the general population and at between 1.5 and 5.5% of the population over 50. Available data suggest that prevalence is similar in the European countries and in the other developed countries, including Spain. Atrial fibrillation is the most frequent arrhythmia in the world, affecting 33 million people, or 0.5% of the global population.

There have been numerous European studies on the prevalence of AF in the different countries in our region. The Rotterdam Study is the most representative in Europe. **The Rotterdam Study** assesses the incidence and prevalence of AF in the population aged 55 and over. A total of 7,983 patients have been followed for around 7 years. AF prevalence was 5.5% of the total population, 0.7% of 55–59-year-olds and 17.8% of the over 85-year-olds. Other studies, like the FAMA Study in Portugal, have assessed the prevalence of AF in 10,447 randomly selected people over 40. Total prevalence was 2.5%, similar in both sexes, increasing with age. Another study carried out in France using diagnostic electrocardiograms on a population of 154,070 people 30 years and older found a prevalence of 0.05% in men under 50 and 0.01% in women under 50; in subjects 80 and over, prevalence was 6.5% in men and 5.2% in women.

The data from the Rotterdam Study have been used to estimate the population that could suffer from AF in the European Union from 2000 to 2060. It was estimated that there were 8.8 million adults with AF in Europe in 2010. If the prevalence of AF remains constant, this number will more than double and could reach 17.9 million by 2060. According to the Rotterdam Study results for the population 55 and over, total incidence was 9.9/1,000 persons/ year, higher for men than for women. Incidence in the 55–59-year-old age group was 1.1/1,000 people/year, rising to 20.7/1,000 persons/year in the 80–84-year-old age group. A recent study of patients 45 and older in the United Kingdom observed an increase in standardised incidence of AF from 5.9 to 6.9/1,000 people/year over the past decade. Other recent studies on the general population recorded incidences of from 0.23/1,000 persons/year in Iceland to 0.41/1,000 persons/year in Germany to 0.9/1,000 persons/year in Scotland.

Overall incidence of AF in the general population worldwide was 60.7/100,000 persons/year for men and 43.8/100,000 persons/year for women in 1990. Estimated incidence was higher in 2010, 77.5/100,000 persons/year for men and 59.5/100,000 persons/year for women (Figure 16). Incidence was significantly higher (roughly double) in the developed countries compared to the developing countries. Applying these incidence rates to the global population in 2010 yielded an estimated 2.7 million new cases of AF in men and 2 million new cases in women each year. There are no prospective studies that can be used to estimate AF incidence in the general population in Spain.

Since AF is common in the elderly, prevalence can be expected to double, at least, in the next 2 or 3 decades. Considering that the prevalence of AF risk factors is also on the rise, this prediction is likely to fall short.

Atrial fibrillation



Figure 16. Prevalence of atrial fibrillation. Source: Revista Española de Cardiología. 2016; 16 Suppl. A: 2-7.

AF is a serious arrhythmia with broad social repercussions. Current prevalence of atrial fibrillation in adults stands at approximately 2-4% but is expected to double or triple in the coming years as people live longer. AF increases mortality by a factor of 1.5-3.5 and the risk of stroke by a factor of 5 and is responsible for 20-30% of ischaemic strokes and 10% of cryptogenic strokes. Embolic stroke tends to be more severe than other types of strokes, with high rates of recurrence and permanent disability.

Furthermore, AF heightens the risk of dementia and causes functional impairment in most patients. It is estimated that approximately 30% of AF patients have to be hospitalised at least once every year. In fact, AF patients are at twice the risk of hospitalisation than patients without AF, particularly from cardiovascular causes (Figure 17).



Figure 17. Most frequent complications of AF. Source: Revista Española de Cardiología. 2021; 21 Suppl. A: 9-17.

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Oral anticoagulant therapy is indicated in AF patients who suffer from an additional condition listed by the **CHA₂DS₂-VASc** scale. Direct oral anticoagulants (DOACs) have a predictable, linear, non-fluctuating anticoagulant effect, eliminating the need for regular anticoagulation monitoring and frequent changes in dosage. Furthermore, on the whole they are also more effective in preventing thromboembolic complications and have a lower risk of intracranial haemorrhage, hence mortality tends to be lower than with non-vitamin K anticoagulants¹ (NOACs) like warfarin² (Figures 18 and 19).



Figure 18. Efficacy and safety of direct oral anticoagulants vs warfarin. Clinical trial meta-analysis. HR: hazard ratio; CI95%: 95 % confidence interval.

Source: Revista Española de Cardiología. 2021; 21 Suppl. A: 9-17.



Figure 19. Stroke risk reduction using oral anticoagulants. *Estimate vs control group. Source: Revista Española de Cardiología. 2021; 21 Suppl. A: 9-17.

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¹ Vitamin K antagonists.

² Warfarin is an oral anticoagulant that inhibits blood clot formation. It reduces blood clotting by blocking the production of vitamin K dependent clotting factors.

The CHA₂DS₂-VASc score should therefore be used for AF patients. This scale is used internationally as a measure of the risk of thromboembolism and stroke in atrial fibrillation patients (Figure 20).

CONGESTIVE HEART FAILURE/LEFT VENTRICULAR DYSFUNCTION				
HIGH BLOOD PRESSURE	1			
AGE 65-74 YEARS or ≥ 75 YEARS	1 or 2			
DIABETES MELLITUS	1			
PREVIOUS STROKE, TIA, OR THROMBOEMBOLISM	2			
VASCULAR DISEASE (PREVIOUS HEART ATTACK, PERIPHERAL ARTERIAL DISEASE OR ATHEROSCLEROSIS OF THE AORTA)				
SEX (FEMALE)	1			

Where "yes" = 1 and "no" = 0 points (except age >75 and stroke, TIA, or previous thromboembolism = 2 points) The score of from 1 to 9 points indicates the risk category and percentage risk of suffering a cerebrovascular accident (stroke) per year.

A	NNUAL STROKE RISK
CHA ₂ DS ₂ -VASc POINTS	PERCENTAGE STROKE RISK
0	0
1	1.3
2	2.2
3	3.2
4	4
5	6.7
6	9.8
7	9.6
8	6.7
9	15.2

Used to decide whether or not the patient requires treatment with anticoagulants or antiaggregants. The table that follows sets out treatment recommendations according to the **CHA,DS,-VASc** score in patients with atrial fibrillation.

CHA2DS2- VASc SCORE	RISK	ANTITHROMBOTIC TREATMENT	RECOMMENDATIONS
0	Low	No treatment (or acetylsalicylic acid)	No treatment (or acetylsalicylic acid 75-325 mg/d)
1	Moderate	Acetylsalicylic acid or oral anticoagulants	Oral anticoagulants, including new anticoagulants like dabigatran or warfarin, carefully monitored to INR values of 2.0-3.0 (or acetylsalicylic acid 75-325 mg/d depending on patient preference and other factors)
2 or higher	Moderate or high	Anticoagulants	Oral anticoagulants, including new anticoagulants like dabigatran or rivaroxaban, carefully monitored to INR values of 2.0-3.0

Figure 20. CHA₂DS₂-Vasc Score. Source: <u>https://1aria.com/images/entry-pdfs/escala-cha2ds2-vasc.pdf</u>.

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Discussion

Cardiovascular risk is the probability of suffering CVD within a certain time window. Accordingly, cardiovascular risk assesses cardiovascular mortality, the set of all fatal and non-fatal cardiovascular complications, myocardial ischaemia complications, both objective complications like acute myocardial infarction and subjective complications like angina pectoris, cerebrovascular complications, etc. Current CVD prevention recommendations emphasise multifactorial risk assessment to arrive at integrated prevention advice for patients. Estimating a person's cardiovascular (CV) risk or coronary disease (CD) risk is an essential tool for clinical decision-making on the interventions needed to bring risk factors under control.

Various scales for quantifying cardiovascular risk have been developed. Their differences lie not only in the two variables mentioned above, which CVD is being considered over which time interval, but also in the specific parameter values used in the calculations. These parameters have traditionally been known as **risk factors**. Their relationship to subsequent CVD incidence has been established for different derivation cohorts, i.e., the populations used to compile risk factor and CVD data, and then plotting time trends. The algorithms thus obtained are checked for those same populations or preferably against other populations called validation cohorts.

The first and second European preventive Task Forces used a chart for estimating coronary risk based on 12 years of follow-up of a combination of the original Framingham cohort and the cohort of their offspring, 5,573 people in all. However, the resulting function was observed to overestimate CD risk in various European populations. The third joint CD prevention Task Force instead recommended using the **SCORE** (Systematic Coronary Risk Evaluation) system in clinical practice. SCORE estimates the 10-year risk of death from CD based on age, sex, systolic blood pressure, total blood cholesterol, and smoking based on 12 studies of European cohorts totalling 205,178 subjects (43% women) ranging in age from 24 to 75.

Asymptomatic Spaniards between 40 and 74 years of age with a 5% risk and thus candidates for intensive counselling are estimated to number in excess of 3 million. This figure does not include others at high risk who have just a single very elevated factor, namely, high blood pressure of 180/110 mm Hg, or elevated total cholesterol, or cholesterol plus elevated low-density lipoproteins (LDL cholesterol). If these are counted, the number of candidates for personalised intervention was 4,646,896 (3,029,913 men, 1,616,983 women) in 2002, plus patients already diagnosed with CVD previously.

These are findings of the SCORE CVD risk scale's calibration study for Spain prepared by the *Instituto de Estudios de la Salud* [Health Studies Institute] in Barcelona in association with the University College Cork's Department of Epidemiology and Public Health in Ireland, the Royal College of Surgeons' Department of Epidemiology and Public Health Medicine, and the Adelaide and Meath Hospital's Cardiology Service, both in Dublin, Ireland. As in other countries, the size of the population of candidates for intensive intervention is quite large, which is not surprising, since cardiovascular diseases are the leading cause of death, hospitalisation, doctor's visits to primary care physicians, and healthcare expenditures worldwide. That is why it is important to take up to date organised preventive measures to keep a health problem that affects a large section of society under control.

At the same time, prevalence of AF is over 4% of the population aged 40 and over. The prevalence of AF has been observed to be rising in the developed countries and is expected to double in Spain in the coming decades as the population gradually grows older, survival rates for CVD patients improve, and AF-related risk factors, obesity in particular, increase.

Conclusions:

Using statistics-based **predictive analytics** and new computer modelling technologies, Big Data, and Machine Learning capable of extracting and generating data and identifying risks and opportunities is extremely helpful.

First, the ability to make projections that enable us to forecast the future from a **preventive medicine perspective** and in that way embark on a paradigm shift towards personalised precision medicine to diminish morbidity and mortality and decrease adverse social impacts.

Second, the ability to reduce claim rates and lower the cost per claim to health insurance companies (medical and surgical healthcare costs). Third, the ability to lower the social cost of public health demands caused by the incapacitating sequelae of ischaemic heart disease (heart attack) and neural conditions from haemorrhagic or ischaemic stroke.

It should be noted that approximately 80% of cardiovascular diseases are preventable and can be delayed by a healthy lifestyle and by rushing to the hospital on observing any warning symptom like chest pain caused by ischaemic cardiac disorders (angina and heart attack) and neurological alterations from cerebrovascular disorders (stroke). Response times are critical and decisive to subsequent evolution of patients with these two disorders, with respect to both mortality and incapacitating sequelae (morbidity).

However, there is still much work to be done in the areas of awareness raising, health education, and preventive public cardiovascular medicine to increase participation by citizens, encouraging people to take a much more proactive role in preventive cardiovascular and cerebrovascular diseases, change their eating habits and lifestyle, and increase their physical activity and daily exercise. This is the only way we will be able to reduce both morbidity and sequelae and the resulting high mortality.

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Artificial intelligence and liability: proposed European Commission directives

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Proposal for a Directive of the European Parliament and of the Council on liability for defective products of 28 September 2022 (Liability for Defective Products - PLD)

Introduction

On 28 September 2022 the European Commission passed two proposals to implement rules on liability to adapt to the digital age, the circular economy and the impact of global supply chains.

In regard to the first Proposal for a Directive of the European Parliament and of the Council on liability for defective products, it should be noted that this implies repealing the now aging Directive 85/374/EEC (the Product Liability Directive or PLD).

The new Directive lays down rules in common on the liability of economic operators for damage to natural persons caused by defective products.



Just as the fundamental aim of the Artificial Intelligence Regulation is to prevent damage, the AI Liability Directive lays down specific guarantees for victims to obtain reimbursement or compensation when such damage arises.

Definitions

"Product" means all movables (movable assets), including when they are integrated into other movables or installed in immovables. "Product" includes electricity, digital manufacturing files and software.

"Damage" means material losses resulting from:

- Death or personal injury, including medically recognised damage to psychological health.
- Damage to or destruction of property, except:
 - the defective product itself
 - a product damaged by a defective component of that product
 - property used exclusively for professional purposes.
- Loss or corruption of data that is not used exclusively for professional purposes.

"Economic operator" means the manufacturer of a product or component, the provider of a related service, the authorised representative, the importer, the fulfilment service provider or the distributor.

Right to compensation

Member States shall ensure that any natural person who suffers damage caused by a defective product ("the injured person") is entitled to compensation in accordance with the provisions set out in this Directive.

Defectiveness

A product shall be considered defective when it does not provide the safety which the public at large is entitled to expect, taking all circumstances into account, including the following:

- the presentation of the product, including the instructions for installation, use and maintenance
- the reasonably foreseeable use and misuse of the product
- the effect on the product of any ability to continue to learn after deployment
- the effect on the product of other products that can reasonably be expected to be used together with the product
- the moment in time when the product was placed on the market or put into service or, where the manufacturer retains control over the product after that moment, the moment in time when the product left the control of the manufacturer
- product safety requirements, including safety-relevant cybersecurity requirements
- any intervention by a regulatory authority or by an economic operator referred to in Article 7 relating to product safety
- the specific expectations of the end-users for whom the product is intended.

Disclosure of evidence (proof)

Member States shall ensure that national courts are empowered, upon request of an injured person claiming compensation for damage caused by a defective product ("the claimant") who has presented facts and evidence sufficient to support the plausibility of the claim for compensation, to order the defendant to **disclose relevant** evidence that is at their disposal.

Member States shall ensure that national courts limit the disclosure of evidence to what is necessary and proportionate to support a claim, and shall consider the legitimate interests of all parties, including third parties concerned, in particular in relation to the protection of confidential information and trade secrets.

Member States shall ensure that, where a defendant is ordered to disclose information that is a trade secret or an alleged trade secret, national courts are empowered, upon a duly reasoned request of a party or on their own initiative, to take the specific measures necessary to preserve the confidentiality of that information when it is used or referred to in the course of the legal proceedings.

Burden of proof

Member States shall ensure that a claimant is required to prove:

- the defectiveness of the product,
- the damage suffered and
- the causal link between the defectiveness and the damage.

The defectiveness of the product shall be presumed, when any of the following conditions are met:

- the defendant has failed to comply with an obligation to disclose relevant evidence at their disposal pursuant to what has been stated above;
- the claimant establishes that the product does not comply with mandatory safety requirements laid down in Union law or national law that are intended to protect against the risk of the damage that has occurred; or
- the claimant establishes that the damage was caused by an obvious malfunction of the product during normal use or under ordinary circumstances.

The causal link between the defectiveness and the damage shall be presumed, when it has been established that:

- the product is defective and
- the damage caused is of a kind typically consistent with the defect in question.

When a national court judges that **the claimant faces excessive difficulties**, due to technical or scientific complexity, to prove the defectiveness of the product or the causal link between its defectiveness and the damage, or both, this shall be presumed where the claimant has demonstrated, on the basis of sufficiently relevant evidence, that:

- the product contributed to the damage; and
- it is likely that the product was defective or that its defectiveness is a likely cause of the damage, or both.

The defendant shall in any event have the right to contest the existence of excessive difficulties or the likelihood referred to above.

The defendant shall have the right to rebut any of the presumptions (iuris tantum) referred to above.

Liability of multiple economic operators

Member States shall ensure that where two or more economic operators are liable for the same damage pursuant to this Directive, they can be held liable jointly and severally.

Limitation periods

Member States shall ensure that a limitation period of three years applies to the initiating of proceedings for claiming compensation for damage falling within the scope of this Directive.

The limitation period shall begin to run from the day on which the injured person became aware, or should reasonably have become aware, of the following:

- the damage
- the defectiveness
- the identity of the relevant economic operator that can be held liable for the damage.

Transparency and review

Member States shall publish, in an easily accessible and electronic format, any final judgment delivered by their national courts in relation to proceedings launched pursuant to this Directive as well as other relevant final judgments on defective product liability.

The publication shall be made without delay upon notification of the full written judgment to the parties.

The Commission may set up and maintain a publicly available database containing the judgments referred to.

The Commission shall, by six years after the date of entry into force of this Directive, and every five years thereafter, review the application of this Directive and submit a report to the European Parliament, to the Council and to the European Economic and Social Committee.

Proposal for a Directive of the European Parliament and of the Council on adapting non-contractual civil liability rules to artificial intelligence (AI Liability Directive) of 28 September 2022

Introduction

The purpose of the artificial intelligence (AI) liability Directive is to lay down:

- 1. Uniform rules for access to information on AI systems.
- 2. Reduce or ease the burden of proof in relation to damage caused by AI systems and establish broader protection for victims (whether natural persons or companies), which will in turn promote the uptake and rollout of AI by increasing both guarantees and legal certainty for companies.

The Directive will harmonise certain rules for claims outside the scope of application of the Directive on Liability for Defective Products (the Product Liability Directive) in cases where the damage arises due to **improper or unlawful conduct** (privacy violations or damage caused by a lack of safety).

Just as the fundamental aim of the Artificial Intelligence Regulation is to prevent damage, the AI Liability Directive lays down specific guarantees for victims to obtain reimbursement or compensation when such damage arises.

The Directive simplifies the legal procedure for victims where this concerns proving that somebody's fault caused damage, by bringing in two core features:

Firstly: in circumstances where significant fault has been established and it appears reasonably likely that there is a causal link with AI, the so-called **"presumption of causality"** will embrace the difficulties which victims face in having to explain in detail how the damage was caused by a specific failure or omission, which is something that can be particularly difficult when it comes to understanding and navigating complex AI systems.

Secondly: victims will have more tools with which to obtain legal relief with the introduction of a **right of access to evidence** (to the relevant proof) in regard to companies and providers for cases where a high-risk AI system is involved.

This Directive will lay down rules in common on:

- the disclosure of evidence relating to high-risk AI systems to allow claimants to establish grounds for their noncontractual fault-based civil liability claims for damages;
- b) the burden of proof in the case of non-contractual fault-based civil liability claims filed with national courts for damage and prejudicial consequences caused by AI systems.

This Directive applies to non-contractual fault-based civil liability claims in those cases where the damage and prejudicial consequences caused by an AI-enabled system occur after the end of the transposition period.

This Directive does not apply to criminal liability.

Definitions

For the purposes of this Directive, the following definitions will apply inter alia:

"Al system": an Al system as defined in [Article 3, section 1 of the Al Act].

"High-risk AI system": a high-risk AI system as defined in [Article 6 the AI Act].

"Provider": a provider as defined in [Article 3, section 2 of the Al Act].

"User": a user as defined in [Article 3, section 4 of the Al Act].

"Claim for damages": a non-contractual fault-based civil liability claim where damages are sought for harm caused by output information from an AI system or for failure of said system to produce output information which it should have generated.

"Claimant": a person who files a claim for damages and who has been harmed by output information from an AI system or due to the failure of said system to produce output information which it should have generated.

"Potential claimant": natural or legal person who is weighing the possibility of filing a claim for damages yet has still not done so.

"Defendant": the person against whom a claim for damages is filed.

"Duty of care": rule on required conduct laid down under national or EU law to avoid damage to legal assets recognised domestically or by the EU, including life, physical integrity, property and the protection of fundamental rights.

Disclosure of evidence (proof) and rebuttable presumption of non-compliance

Member states will ensure that national courts are empowered to order the disclosure of evidence, whether (i) at the request of a potential claimant who has previously asked a provider, a person who is subject to the provider's obligations, or a user to disclose the relevant evidence in their possession **with regard to a certain high-risk AI system which is suspected to have caused harm** but where their petition has been declined, from such persons, or (ii) at the request of an actual claimant.

In support of this request, the potential claimant must submit sufficient facts and evidence to sustain the feasibility of a claim for damages.

The national courts are to confine the disclosure of evidence and the measures to preserve it to what is necessary and proportionate to support a potential or actual claim for damages.

In deciding whether an order to disclose or preserve evidence is proportionate, national courts will take account of the legitimate interests of all parties, including third parties affected – particularly those interests concerning the protection of trade secrets and confidential information such as, for example, that which relates to public or national security.

When, in the context of a claim for damages, a defendant fails to comply with an order by a national court to disclose or preserve evidence in their possession, the national court will **presume non-compliance** on the part of the defendant with a **relevant duty of care obligation**; in particular, in those circumstances to which Article 4, sections 2 or 3 allude, that the evidence requested was intended as proof for the purposes of the associated claim for damages.

The defendant will have the right to rebut this presumption (*iuris tantum*).

Rebuttable presumption of a causal link in the case of fault

Without detriment to the requirements laid down in said Article 4, national courts will, for the purposes of applying the rules on liability to claims for damages, presume a causal link between the fault of the defendant and the output which the AI system produces or fails to produce, **provided that all of the following conditions are met:**

 the claimant has demonstrated, or the court has presumed, pursuant to Article 3, section 5 (non-compliance with the relevant duty of care), the **fault of the defendant** or of a person whose behaviour is the responsibility of the defendant which consists of non-compliance with a duty of care laid down under EU or national law that is directly intended to provide protection against the damage that has been caused;

- it may be considered **reasonably likely**, based on the circumstances attending each case, that **negligent conduct has influenced** the output which the AI system produced or failed to produce;
- the claimant has demonstrated that the information output which the AI system produced, or its failure to produce output, **gave rise to the damage**.

In the case of claims for damages **relating to high-risk AI systems**, national courts will not apply a presumption of causality where the defendant proves that the claimant can reasonably access sufficient evidence and expertise to prove the above-mentioned causal link.

In the case of claims for damages **relating to non high-risk AI systems**, a presumption of causality will only apply where the national court **considers it excessively difficult for the claimant to prove the causal link**.

In the case of claims for damages against a defendant **who has used the AI system during a personal, nonprofessional activity**, the presumption laid down will only apply when the defendant has materially interfered with the conditions of operation of the AI system or when the defendant was required and able to determine the conditions of operation of the AI system and failed to do so.

Finally, we must point out that the defendant will have the right to rebut the causality presumption.

Evaluation and targeted review

The Commission shall, within the space of five years after the end of the transposition window at the latest, review application of this Directive and submit a report to the European Parliament, to the Council and to the European Economic and Social Committee accompanied by any proposal of legislation.

The report will examine the effects of Articles 3 (disclosure of evidence and presumption of non-compliance) and 4 (presumption of a causal link) on achieving the objectives pursued by this Directive.

In particular, it must assess the suitability of the rules on strict (no-fault) liability for claims against the operators of certain AI systems – whenever these have not already been regulated by other EU liability rules – and the need for insurance, while at the same time bearing in mind the effect and impact on the general rollout and take-up of AI systems, especially for SMEs.

Conclusions:

It appears significant that at a time when the Artificial Intelligence Regulation is still going through (at the time of going to press of this article it still had not been approved) in September 2022 the European Commission presented the two proposals for Directives which we have just outlined in the sections above.

The first of the proposals proposes to modernise the current rules on strict liability of manufacturers for defective products. In the commission's own words, the revised rules will provide legal certainty for businesses to be able to invest in new and innovative products and ensure that victims can obtain fair compensation when defective products cause harm, including digital and reconditioned products.

As we have seen, the proposal for a Directive on liability for damage caused by defective products provides cover for strict liability of producers who place defective products on the market.

The definition of a product expressly includes both digital manufacturing files and software. And the concept of damage includes material losses from the loss or corruption of data that is not used exclusively for professional purposes.

In respect of a person harmed by a defective artificial intelligence system, consumer protection is firstly framed by the right they have for the various economic operators to disclose to them any relevant evidence or proof that is available to them.

Secondly, the defectiveness of the product will be presumed when any of these situations are present: there is non-compliance on the defendant's part with the obligation to disclose evidence; if the claimant proves non-compliance with the mandatory safety requirements or the claimant establishes that the damage was caused by an obvious malfunction of the product.

Thirdly, a new presumption means that the causal link between the defectiveness of the product and the damage shall be presumed where it has been established that the product is defective and the damage caused is of a kind typically consistent with the defect in question.

With the second proposal for a Directive reviewed, for the first time the Commission is proposing specific harmonisation of the national rules on AI liability, which would make it easier for victims of AI-related harm to obtain damages for it.

To achieve its intended aim of providing legal relief, a right of access to evidence (to the relevant proof) is being established in regard to companies and providers for cases where a high-risk AI system is involved. Here, when the defendant fails to comply with a court order to disclose or preserve evidence in their possession, the court will presume non-compliance with a relevant duty of care. This is without detriment to the defendant's right to rebut or contest such a presumption *iuris tantum*.

Secondly, national judges and courts will presume a causal link between the fault or negligence of the defendant and the harmful output which an AI system produces or is unable to produce when a set of conditions which the Directive itself describes are satisfied.

Within the scope of definitions, we can highlight the legal concept of "potential claimant", meaning a natural or legal person who is weighing the possibility of filing a claim for damages yet has still not done so.

To sum up, this proposal for a Directive establishes a fault-based liability system which, at least for the time being, leaves out the possibility of including a system of strict (no-fault) liability, which it seeks to counterbalance with a system of presumptions *iuris tantum* that is rebuttable. This is a system which in any event is understood to be supplementary to the system laid down under the Directive on liability for defective products.

The insured interest and distinguishing it from the insured risk

Comment on the judgment by the Civil Division of the Supreme Court of 1 March 2023

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Introduction

In general contract theory, consent, consideration and the subject-matter are the three essential elements. In an insurance contract, the consideration is the insured risk, whereas the subject-matter is the insured interest. In both cases, if they are not present, the Insurance Contracts Act ("LCS" for the Spanish) declares the contract null and void.

Hence, with respect to the insured risk, Article 4 of the LCS states that "The insurance contract shall be null and void, save in those cases envisaged in Law, if the risk did not exist or the loss event had occurred when it is concluded." Along similar lines, Article 25 of the LCS determines in regard to the insured interest that "Without detriment to the provisions of Article 4, a contract for insurance against loss or damage is null and void if, at the time when it is concluded, there is no interest of the insured upon compensation of the loss or damage."



The economic interest which the person has in the loss event not occurring constitutes a legitimate purpose of coverage in a contract for an insurance policy against loss or damage, the rationale for which lies precisely in obtaining compensation for harm to the interest. The loss event is thus the materialisation of the risk and the harm to the insured interest.

Whereas the risk is the possibility of a chance event happening that prompts a want of assets, the insured interest is not strictly speaking the item insured, but rather the interest in it which the contracting party has. This is why we refer to an interest of the owner, usufructuary, mortgagee, etc¹.

Although both elements — risk and interest — may give rise to some confusion and appear intertwined, the fact is that they differ and perform separate roles in the insurance contract. The risk endows the contract with its random essential nature, whereas the insured interest represents the reason for the asset-related attribute which compensation involves. The non-existence or disappearance of the interest excludes the possibility of the loss or damage and acts as a block to the insurer's duty to compensate. If there is no interest, no loss or damage to it can occur. And if there is no loss event, then there is no detriment or injury to remedy or indemnify².

¹ This is how the risk and interest insured are defined in GARRIGUES J., *Contrato de Seguro Terrestre*, edition published by J. Garrigues, 2nd edition, 1982, pp. 9 and 18.

² See COLINA GAREA R, "Comentario al artículo 25", in BADILLO ARIAS, J.A. (coord.), *Ley de contrato de seguro: jurisprudencia comentada*, publ. Aranzadi, 4th edition, Cizur Menor, Navarre, 2022, page 634.

The judgment by the Civil Division of the Supreme Court of 1 March 2023

It cannot be claimed that a great deal of Spanish High Court case law exists on these two essential elements of the insurance contract, above all as regards what we should understand by "insured interest." It therefore seems useful to pass comment on this recent judgment which concerns precisely these two particular elements of the insurance contract, as well as the distinction between them.

Thus, it is that the Supreme Court builds its authoritative decisions in regard to these two elements upon what is a basic factual background.

Factual background

The events which produced this decision are as follows: a woman bought a home through a court auction and had it recorded on the Land Register in the name of a legal arrangement for property jointly owned by her and her husband.

On 20 May 2016 an application for an eviction order was filed against the occupant of the auctioned-off property and on 22 June 2016 the litigating parties together took out a multi-risk homeowner's insurance policy – without even entering the home or the insurer broaching the subject of a questionnaire form – for a sum assured of 54,000 euros for the structure and 7,000 euros for contents. Likewise, for cases of vandalism the full amount of the sums assured was agreed.

On 27 July 2016, the court delegation handed over the residence to the claimant. Upon taking possession of the premises, they witnessed the damage which was apparent inside it and noticed that the furniture had been removed. That very day the claimant filed a formal complaint with the Guardia Civil (Civil Guard) and the following day they reported the loss to the insurer who, having opened the vandalism case file turned down the claim, arguing that "the consequences reported were inconsistent with the actual facts."

Subject of the claim and the insurer's objection

Following the damage caused and the insurer's rejection, the insured filed a claim for the amount of 33,581.02 euros for damage to the structure and 7,670.19 euros for loss or damage to contents.

The insurer contested the claim for several reasons, chiefly on the grounds of there being no insured interest at the time when the policy was taken out (Article 25 of the "LCS", the Insurance Contracts Act), arguing that when the insurance contract was entered into the policy holder still did not have possession of the premises subject to litigation and had not entered its interior, meaning that they were not aware of its state. It thus understood that the contract was null and void under the terms stated in Article 25 of the LCS.

Moreover, in regard to the structure, it was alleged that "the date of the loss event" was not known "and therefore it cannot be determined whether the insurance contract was already in effect or not". Regarding the contents, the insurer contended that "there is a lack of active legitimation on the part of the claimant given that they have not been the owner of any of the items of furniture in the home before or after the insurance contract and it is not even known whether they were owned by the previous owner or even the occupant or in what amount or capacity." Finally, having acknowledged that it had not made the policy-holder fill out any questionnaire given that the policy was taken out over the telephone, the insurer cited Articles 10 and 11 of the LCS, alleging that the insured was the owner of the home, the possession of which was still pending judicial handover, without informing the company of this.

Lower court judgments

In short, the judgment by the court of first instance was of the opinion that there was an insured interest as referred to in Article 25 of the LCS, since, when the policy was taken out, the claimant was the owner of the premises, even though they were unaware of what state it was in.

With respect to intentional misconduct or gross negligence on the part of the policy holder, as well as the possibility of the loss event having taken place before the policy was taken out, it took the view that these are facts which it behoves the insurer to prove, all the more so when there is no record of the company having made the claimant complete an appropriate questionnaire for the purposes of weighing up the circumstances which ought to have had a bearing on assessing the risk involved.

The judgment did not, however, admit the items under contents, since it was given to believe that in this particular case there was no insured interest on the grounds that the furniture did not belong to the claimant.

Even so, in ruling on the appeal filed by the insurer, the judgment by section six of the Seville Provincial Court overturned that of the first court, arguing that, just as the insurer maintained, there was a lack of an interest on the part of the policy holder, given that when the act of insuring took place the claimant had not entered the interior of the property which it was insuring (as the particulars of claim themselves recognise), meaning that they were not aware of what state the inside of the property was in, while there was no proof at all that the damage finally noted might have been caused after the insurance policy had been taken out.

Matters being thus, in the view of the Provincial Court at the time when the policy was being taken out the insurance did not involve any interest, and therefore pursuant to the provisions and subject-matter regulated under Article 25 of the Insurance Contracts Act to the extent that this relates to Article 4 thereof, the contract signed between the parties was rendered null and void and it cannot produce the consequences which the claimant seeks.

The appeal to the Supreme Court

The judgment by the court of first instance having been overturned and the allegations of the insured dismissed, the insured filed an appeal with the Supreme Court, repeating the line of argument which they had affirmed throughout the entire legal process. In essence, it held that there was an insurable interest (Article 25 of the LCS) given that the policy holder was the owner of the damaged property and took out the cover with the warning that it was to be used to rent out; in other words, normally in such circumstances possession of the premises does not fall to the owner but instead to anybody to whom the use thereof has been passed.

Regarding the company's allegation that paying out compensation was not in order because no accreditation was supplied of the exact date of the loss event, while citing Article 10 of the LCS, the court dismissed these grounds for objection based on the fact that the claimant was not required to complete a questionnaire at all and, that since the company did not bother to confirm the date upon which the loss event took place, the only remaining alternative was to find in favour of the claim.

To summarise, it concluded that "... in the case of an owner who has not been asked for proof of insurance either when the policy is taken out or when collecting the premium, it cannot be asserted that no interest exists when the loss event occurs if we bear in mind that they are the owner of a property and in taking out the insurance policy they clearly state that other people will be using the premises."

Authoritative decisions of the Supreme Court

The Supreme Court pronounces on certain matters which might be held to fall within its specialist area of doctrine and which appear to us useful to highlight in regard to this appeal filed with it, where, broadly speaking, it accepts the claimant's complaint.

The concept of insured interest

The court takes the view that in this case there does exist an insured interest on the part of the insured, who is the claimant in these proceedings, since they are the owner of the property which they had acquired via a court auction. The economic relationship which they have with the item is self-evident and the fact that they might seek to guard against impairment or harm that it might suffer on account of an act of vandalism represents an undeniable legitimate goal. Their interest is therefore hard to call into question right from the moment when they bought the home and it became part of their joint property arrangement.

It thus holds that "the interest becomes a special element in insurance contracts, and not only in insurance against loss or damage but also in insurance of persons. Were this not the case, then the insurance would be transformed into a straightforward bet. It is essential that the policy states the insured interest, so it is necessary for specification to be made of 'the item wherein insurance takes place' (Article 8.2 LCS)."

The High Court recognises that in Article 25 the LCS does not define what should be understood by insured interest and it therefore turns to case law. Here it brings in Judgment No. 997/2002 of 23 October which, citing the judgment of 16 May 2000, states that "in the orbit of insurance law the interest is constituted by the economic relationship that exists between an individual and an asset that represents the subject-matter covered by the policy." And on the other hand, Judgment 681/1994 of 9 July says that "in insurance against loss or damage the insured's interest in the case of justified compensation as a consequence of the insured risk amounts to a prerequisite for the contract to be valid."

The economic interest which the person has in the loss event not occurring constitutes a legitimate purpose of coverage in a contract for an insurance policy against loss or damage, the rationale for which lies precisely in obtaining compensation for harm to the interest. The loss event is thus the materialisation of the risk and the harm to the insured interest.

The court holds that the interest not only relates to the owner of the item but also to whoever has an interest under other forms of legal title, as Supreme court Judgment No. 260/2006 of 23 March establishes when it states that "... according to doctrine and case law, the insured interest in a contract against loss or damage can not only lie in the ownership the property insured, but also arise from some other economic association in connection with it, such as having title to a secured mortgage loan via the property alluded to, since in such a case the insured interest boils down to upholding the integrity of the mortgage security to satisfy the loan in the event of default."

Therefore, in the case which concerns us here, it is clear that the claimant has an interest in the structure, since they own the home. However, in regard to the contents, the claimant lacks an insurable interest given that the title which

supports their ownership derives from the judicial sale in foreclosure proceedings, wherein the existing furniture was not part of the auction and corresponding allocation to the husband of the claimant, as the court of first instance rightly determined.

The relationship between the insured interest and the insured risk

The court then holds that there is an intimate relationship between the interest and the risk, given that for the insurance to be effective the property regarding which there is an interest must be subject to a risk. As we said at the outset, we find ourselves confronted with two out of the three essential elements in an insurance contract (the third being consent).

Nevertheless, the fact that these elements are intertwined does not make them identical. As we have seen, they are subject to different regulation: risk comes under Article 4 of the LCS, whereas the interest is regulated by Article 25 of the LCS. In both cases, if they are not present, the contract is declared null and void.

Even so, risk is the possibility of a loss event occurring, and it is the core and sinew of the insurance contract, while the contract is entered into precisely as the antidote or antibody for it. In the court's opinion it is possible for there to be risk and no interest; for example, in the case of Court Division 1's judgment No. 10/2005 of 31 January 2005 the insured interest was held to be non-existent because tenant status regarding the premises had been lost when the fire broke out. It is clear that in that case the risk that was the subject of the coverage materialised but the policy holder was unable to claim compensation for the detriment as they had lost their economic interest in the item.

On the duty to state risk

Another of the controversial issues in these proceedings is the insurer's allegation that the insured did not declare the true insured risk on the terms of Article 10 of the LCS. Nevertheless, drawing on its abundance of case law concerning this Article, the court holds that, more than a duty to declare, this is a duty on the part of the policy holder to answer or reply to what the insurer asks them, since the insurer has a greater awareness of the importance of the facts for the purposes of accurately assessing the risk and therefore has to ask the contracting party for any information which it deems opportune.

This arrangement was clarified and buttressed (if possible) by amendment of the first paragraph of said Article 10 with the addition of a final subsection according to which "(the policy holder) shall be exonerated from this duty if the insurer fails to make them complete a questionnaire or when, even doing so, there are circumstances that could have a bearing on assessment of the risk and which are not included therein." Consequently, with regard to case law the policy holder's obligation to state all the circumstances of which they are aware that might influence the risk assessment before conclusion of the contract and according to the questionnaire which the insurer requires them to complete is fulfilled "by answering the questionnaire which the insurer presents to them, while the insurer assumes the risk in the event of not presenting it to them or doing so in a manner that is incomplete."

In the case before us here, the insurer had the chance to perform risk assessment by requiring the claimant to fill in a suitable questionnaire, which it chose not to do of its own free will. It thus has to assume the consequences of not having availed itself of the questionnaire. On top of this, there is no proof of when the damage to the home took place, or that the insured was aware of the damage when they took out the policy.

Agers operational risk handbook

María Nuche Otero Risk Management Director Consorcio de Compensación de Seguros

The presentation of the Operational *Risk Handbook of AGERS* (the Spanish Insurance and Risk Management Association) took place in September 2022, a manual written by the members that make up the Committee of Larger Companies Risk Experts, on which sits María Nuche, the Risk Management Director representing the Consorcio de Compensación de Seguros.

This committee of experts comprises risk officers at larger companies who operate in different sectors yet share the task in common of contending daily with managing uncertainty to help add value within organisations and bed down a robust corporate governance system.

The document seeks to provide a practical handbook to identify and manage operational risk, which is a kind of risk that is inherent to all the activities, products, services, systems and processes at any type of company regardless of its size and legal form.

To this end, the handbook contains different sections which examine aspects such as the concept of operational risk; integrating operational risk management into



The strategic tool for operational risk management is risk analysis. Such analysis includes recognising risk by identifying and evaluating it, the methodology that applies to measuring it (including qualitative, and semi-quantitative and quantitative methods), monitoring it and tracking it via indicators, and developing methodologies and techniques to quantify operational risks.

corporate activities; analysing, evaluating and quantifying operational risks; mitigating them, and the regulatory frameworks currently in place to manage this type of risk.

The concept of operational risk is examined from the perspective of the various definitions of it which different institutions and regulations have determined over the course of time. Generally speaking, it is defined as the risk of losses derived from inadequate or failed internal processes, personnel or systems, as well as that which stems from external factors. It embraces legal risk, though not strategic or reputational risk.

The definition embodies a set of characteristics in common, such as heterogeneity, and the breadth and complexity of evaluation, representing a genuine challenge for companies, who are aware that operational risk management is a key component of any organisation's strategy if it is to achieve its objectives.

Operational risk management has to be built into the activities of organisations. To do this, it must be properly identified within all areas of the organisation, evaluated according to impact and probability parameters, prioritised in line with the company's risk appetite policy, and lastly monitored by overseeing the risk actions that have been identified.

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Identifying an organisation's operational risks involves using various different sources of information, both in-house and external. One could start with the operational risk classification of the Operational Risk Insurance Consortium (ORIC), an institution comprising the UK's leading insurers. According to this classification, operational risks can pertain to any one of these groups: internal or external fraud, customers, business products and practices, harm to physical assets, business interruption or system crashes, and risks within business processes. The identification process includes analysing the causes and origins of risks, their exposure and their impact on goals.

Implicit to measuring operational risks is determining their impact and probability, while other factors can also be taken into account, such as the speed or swiftness of the impact and how long it persists or lasts once the risk has materialised.

Methodologies for measuring operational risks can be qualitative, semi-quantitative or quantitative:

- Qualitative analysis looks at words, description and scaling to define risk probability and impact. It is mainly performed via interviews, workshops, surveys and similar techniques.
- Semi-quantitative methods work with qualitative scales expanded by assigning categories with which to make a numerical classification. This allows heat matrices to be made and risks to be prioritised.
- Quantitative methods are based on probabilistic or non-probabilistic techniques to prioritise exposure to risks in numerical terms. Such analysis is complex and expensive, so it is generally confined to evaluating key risks.

Once operational risks have been identified, the organisation must take a decision on how to deal with them. The most common response in the case of operational risks is their mitigation or control, which will be framed after making a due cost-benefit analysis of the measures taken. Even so, there is the possible alternative of transferring them to the insurance market, which will only be possible for those risks which satisfy a set of characteristics that make them insurable.

This whole process of analysing operational risks must be performed within current frames of reference and regulatory frameworks that apply depending on the type and activities of organisations.

Prominent among the regulations applying to operational risk management are the Corporate Enterprises Act, the recommendations of the Spanish National Securities Market Commission (CNMV), the Solvency II regulatory framework and the rules and regulations that apply to the banking sector. As regards methodology frames of reference, we might cite ISO 31000, the Three Lines (of Defence) Model (M3L), the Federation of European Risk Management Associations (FERMA) or the international framework of the Committee of Sponsoring Organizations of the Treadway Commission (COSO).

In closing, it is worthwhile giving consideration to the future of operational risk management, particularly bearing in mind the influence of the new technologies. Companies face five key challenges:

- Reshaping the role of risk officers.
- Developing a culture of risk awareness at the organisation.

- Developing swifter and more flexible risk management practices at the organisation.
- Adapting risk management to big data and the analytical tools which AI offers.
- Developing and adapting talent and the right skill-set in risk management for what the future will call for.

Working on these goals will allow organisations to integrate risk management into the business and corporate processes, thereby ensuring more effective risk management.

Some readings for a climate crisis

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The growing evidence that there is something utterly wrong with the climate makes it more and more unnecessary to make efforts to convince sceptics that we are amidst a climate crisis or, as the Spanish legislation states, a climate emergency. The term 'climate change' might be too weak for, indeed, as a mean of the changing states of the weather, climate itself always changes and has changed –a lot– through the eons by natural causes. Nevertheless, there is currently no doubt that the human-caused alteration in the chemical composition of the atmosphere, by means of greenhouse-effect gas emissions and land-use changes, is the cause of a global warming and a climate change at a pace never experienced by *Homo sapiens* all along its existence.

The changes are impacting all the components of the climate system: weather, oceans, ice caps, and biosphere and, hence, all the human economical activities depending on and related to them. All these elements are now imbalanced and that is how the term of climate crisis, as we will discuss later, is much more suitable to describe the current and, undoubtedly, future challenge that humanity must face. The thorniest issue is that humans are both the most affected and also the only cause of the problem, and worst effects



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mitigation and damage-control are in their hands, but the most effective solution is cutting emissions as much (ideally, completely) and as soon as possible. This solution means dismounting the way society has dwelled, and prospered, and multiplied as never before, since the Industrial Revolution, and transitioning to a sustainable way. This process is already in motion, but has to face huge resistance forces, driven by inertia and by powerful interests.

The Assessment Reports of the United Nations Intergovernmental Panel for Climate Change (IPCC), its Sixth report recently issued in 2022, are by far the most authoritative, contrasted and comprehensive source to learn about the irreversible changes imposed to the climate system and about the projections for the rest of the century according to different socioeconomic pathways. These reports, though, are lengthy (nearly 8,000 pages) and sometimes very technical, meaning that there are more accessible readings (apart than the own Summary for Policymakers included in the Assessment Reports), some of which we are going to review here.

Starting by a modern classic of 2005, not directly related with climate change or the climate crisis, although it perspires through its pages, *Collapse*, by the veteran and renowned geographer Jared Diamond is a thorough and long reflection along the causes that make human societies fade and, eventually, disappear. By studying famous cases such as Rapa Nui/Easter Island, the Middle Age Viking settlements in Greenland or the Maya civilization, Diamond establishes how both external and internal causes, together with the application of wrong or ill adapted solutions –in a changing context, what worked before can no longer work or can even make things worse–, are behind the ruin and decline of many societies along History. There are obvious lessons to be learned for the current climate crisis.



More focused on the matter-atstake is *The Uninhabitable Earth: a story of the future of 2019*, by the journalist David-Wallace-Wells, who makes a review of the potentially more devastating effects of the climate breakdown:



cascade effects, sea-level rise, political conflicts and economic collapse. Even though the intentions of the author are based on rising awareness on the importance of taking action now to avoid the worst effects of climate change later, no doubts an impending need, his reiteration on focusing on the worst consequences, some of which are mentioned but with a low degree of consensus between the thousands of IPCC contributors, can create an undesired effect on the reader. More on this, later.

The volcanologist and IPCC contributor Bill McGuire's work, *Hothouse Earth: an inhabitant guide* of 2022 stands along the same

conceptual idea of the former book: raise awareness to try to keep global warming below 1.5 °C, the pre-industrial mean temperature, but is more centred on the facts and the consensual projections. It is a short, focused and easy to read book.

The next book reviewed here is *The New Climate War: the fight to take back our planet*, by the prominent meteorologist Michael E. Mann, of 2021. Mann, with a direct and sometimes confrontational style, explains how it is the collusion of interests between oil companies, petro-states and some political and media groups that has made climate change mitigation go slower than needed. This is made by propagating hoaxes on the scientific solidity of climate change science, on the effects observed and on blocking consensus in the many Conferences of the Parties (COPs) devoted to develop binding agreements among states to reduce emissions and mitigate climate change. Another way to delay the energy transition is setting the responsibility of the



emissions on the personal behaviour of individuals and not in state regulations which would be binding for all sectors of the economy. Obviously stating the importance of more sustainable personal ways of life, Mann sets the example of the 4% reduction of emissions during the COVID-19 lockdown as the demonstration that it would not be just our


personal responsibility the one that would save us from the worst effects of the climate crisis. A much deeper intervention from state and multilateral actors is needed to de-carbonize our future.

Mann, as well as McGuire, praises the importance of movements such as Fridays for future, led by Greta Thunberg and her generation, who will live through worse years of this crisis, to ask for accountability from those responsible for not acting quicker. They, together with the growing effects already present, have created a change of tide in global opinion, corporations and most governments, that is starting to have an impact in emissions rates and in setting this crisis at the centre of world policies. Mann also criticizes what he calls 'doomists', and sets the article by Wallace-Wells as a perfect example. This kind of literature, which he labels as 'climate-porn', can lead to inaction by demoralising and by thinking that it is too late to avoid our fate. It is not, and although probably at a slower pace than the one desirable, society is already on it.

In this more positive line, the last book reviewed here, *Values*, of

2021, by the former Governor of the central banks of Canada and England and current UN Special Envoy for Climate Action and Finance, Mark Carney sets the focus on the need for reformulating the values behind Economy. With the examples of the Global Financial Crisis of 2008, the COVID-19 Crisis and the Climate Crisis, Carney elaborates a fascinating discourse on how to build value for all, with leadership, fairness and responsibility. It was Pope Francis who inspired Carney, in a reception to central bank governors, making the comparison of wine, which is a good complement of food and has a moderate quantity of alcohol that enlivens the mind and enriches the senses, and grappa, which is wine distilled and only has alcohol. The Pope made an analogy between Humanity and markets, which are humanity distilled, and challenged leaders to turn grappa back into wine and make more human markets and Economy that should be essential tools to navigate these crises. As they are created by a crisis of values, *Values* is Carney's answer to this challenge. There is hope.



Mark

Carney

An Economist's Guide to Everything That Matters

'A roadmap to a fairer and more responsible, resilient world'

> 'A remarkably good read'



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