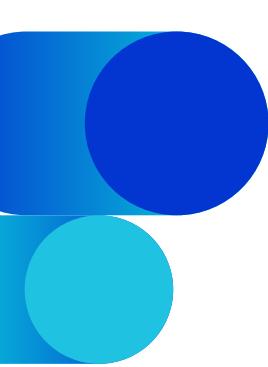


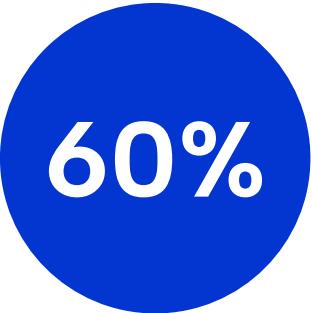


# NDT-Scanner FDP

Group 23

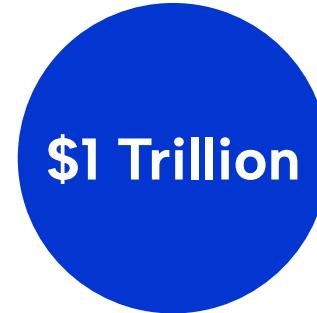


# Background



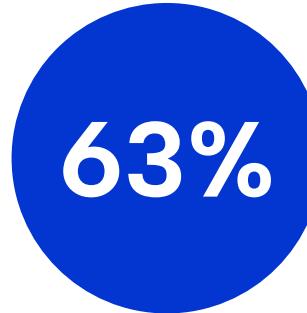
60%

CUI contribution to piping  
maintenance cost



\$1 Trillion

Lost annually in oil and gas  
industry due to corrosion



63%

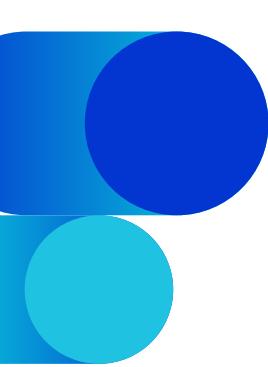
Cost savings as a result of  
CUI robots



# Corrosion Under Insulation

- Corrosion under insulation (CUI) occurs when moisture is trapped between pipe insulation and the surface of a steel pipe
- CUI can go unseen due to the insulation layer, slowly decreasing wall thickness and affecting plant operations
- Common in oil and gas, petrochemical, and power generation industries, which must closely monitor their pipes in order to maintain plant efficiency
- Since it is difficult to detect, it can cause leaks, failures, and other repair costs which can all be substantial over time



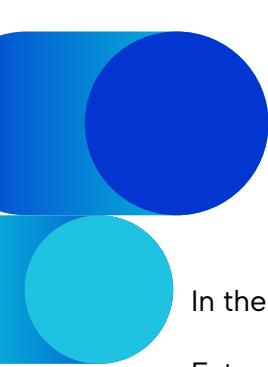


# Economic Impact

Corrosion under insulation (CUI) contributes to **40–60% of piping maintenance costs** in the oil and gas industry [1], with total corrosion-related costs approaching **\$1 trillion annually** worldwide [2].

Unplanned production outages offshore cost between **\$1–2 million per day**, and platforms may lose **\$38 million annually** due to integrity-related failures [3].

Robotic CUI inspection has demonstrated up to **63% cost savings, 99% scaffolding reduction**, and **inspection timelines cut from 9 months to 39 days** [4].



# Safety and Risk

In the EU, **more than 20% of major oil and gas accidents** since 1984 were linked to CUI [5].

External corrosion (including CUI) causes **approximately 60% of U.S. pipeline leaks** [6].

At onshore oil facilities, **nearly 50% of hydrocarbon leaks** stem from CUI [5].

Failures on pressure vessels and risers due to undetected CUI pose **catastrophic environmental and safety risks** [7].





# Inspection Challenges

Offshore platforms contain **several kilometers of insulated piping and numerous insulated vessels**, making full inspection difficult [8].

Traditional CUI inspections require **70–80% of the cost** to be spent on scaffolding and insulation removal alone [9].

Random sampling after insulation removal reveals corrosion in **only 0.2–0.3% of inspected spots**, indicating extremely poor detection efficiency [9].

Current methods (e.g., UT, PEC, radiography) each face **limitations in resolution, coverage, or accessibility** [10].





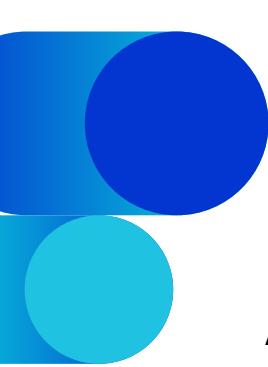
# Environmental Stressors

Marine installations face **ISO C5-M-class conditions**, with **salt spray, 100% humidity, and UV exposure** that accelerate CUI onset [11].

Daily **thermal cycling and condensation** under insulation are common, particularly in the 50–120 °C “CUI danger zone” [12].

Insulation deterioration and deluge system exposure cause **persistent moisture retention** even without visible exterior damage [12].

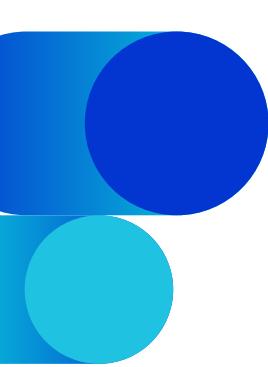




# Regulatory Standards

API 570 recommends **3–5 year intervals** for CUI-prone equipment [13].

API RP 583 and DNV-RP-G109 emphasize **risk-based inspection (RBI)** and data-driven prioritization, which require better inspection coverage [14].



# Opportunity for Portable CUI Scanner

A handheld or robotic CUI scanner could:

- Reduce costs by over **50%** [4],
  - Enable **routine scanning during operations** (not only shutdowns) [10],
  - Feed **quantitative data into RBI** models [14],
  - Detect early-stage corrosion, reducing leaks and failures [4],
  - Improve safety by minimizing the need for high-risk rope access or insulation removal [8],
  - Pay for itself quickly by avoiding **even a single leak or shutdown** [3].
- 



## Needs Statement

A need exists to provide industries that use insulated steel pipes with a simple, affordable method to detect corrosion under insulation, since current solutions are costly and primarily designed for large-scale sites.



# Problem Statement

Design a low-cost, modular, and non-destructive testing device that an operator can roll along insulated pipes which provides a real-time visualization of corrosion under insulation. This solution should be able to adapt to various pipe sizes and geometries.

# Criteria



## Accuracy

Ability to provide consistent and accurate measurements of corrosion and wall thickness.



## Speed

Speed in traversing pipe surface helps minimize inspection time.



## Cost

Overall cost of the solution must be within allocated budget.



## Mass

Light weight allows ease of handling over long periods of time.



## Size

Size of device must be small enough to be comfortably controlled by operator.



## MFG

Minimal number of parts and simple mechanism.

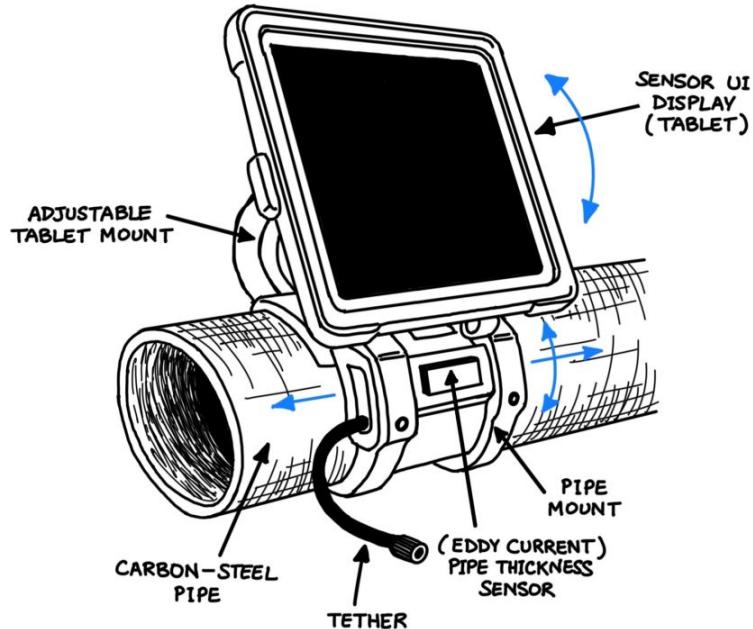
# Design Specs: Objectives

Criteria	Objectives	Unit of Measurement	Notes
Accuracy	>10	mm	Detect corrosion of >10mm consistently.
Cost	<1000	\$	Universally allocated budget
Size	500x150	mm	Total size
Movement Speed	>0.1	m/s	With operator control
Mass	<10	kg	
Manufacturability	<2	hr per unit	With off the shelf parts
Pipe diameter compatibility	4 to 8	inch diameter	

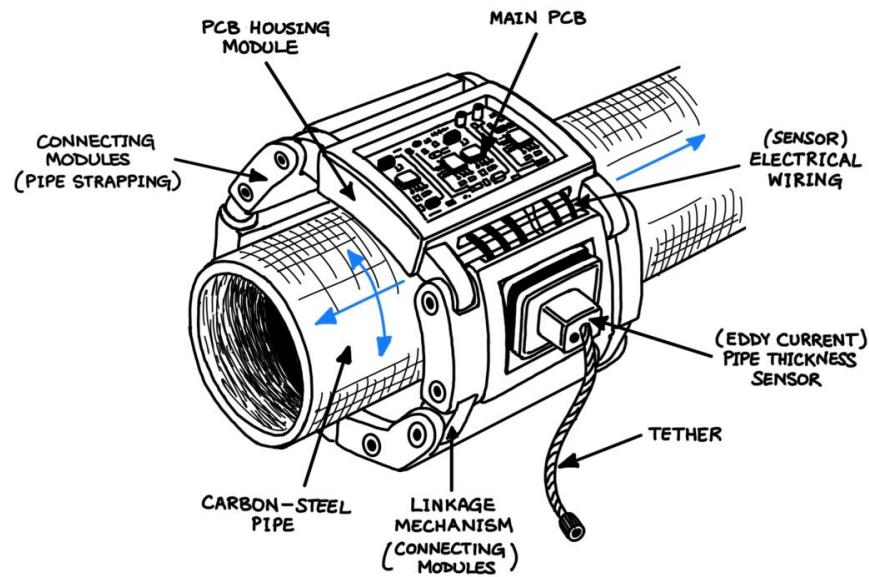
# Design Specs: Constraints

Criteria	Objectives	Unit of Measurement	Notes
Accuracy	>20	mm	Detect corrosion of >20mm consistently.
Cost	<1500	\$	Universally allocated budget
Size	750x150	mm	Total size
Movement Speed	>0.5	m/s	With operator control
Mass	<20	kg	
Manufacturability	<5	hr per unit	With off the shelf parts
Pipe diameter compatibility	4 to 6	inch diameter	

## Design #1

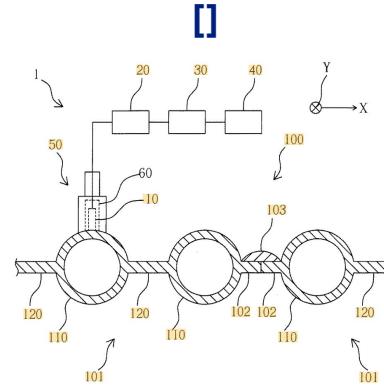
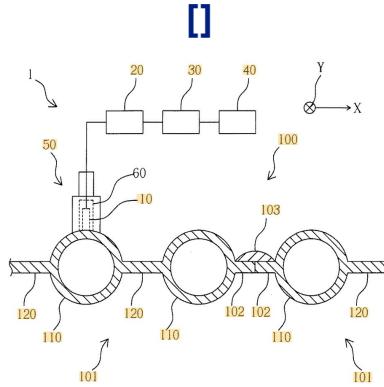
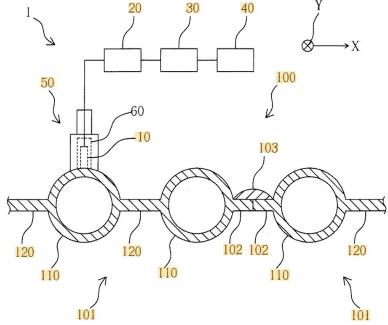


## Design #2



# Patent Research

[JP6175091B2]



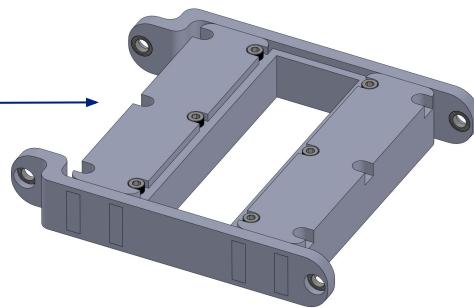
- Eddy current inspection probes
- Dual coil probe with AC magnetization
- Curved jig keeps coil winding direction correct
- Two step calibration
- Targets boiler tubes

# Rev1 Design



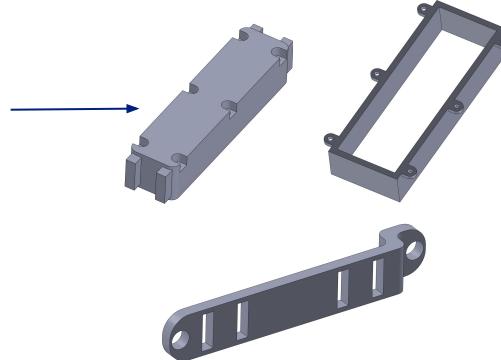
## Full Asy

Three modules are joined to form a semi-circle that wraps around pipes



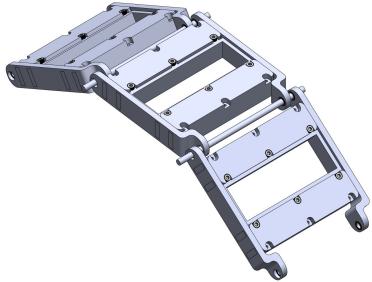
## Module

Each module uses the same sub-components ensuring adherence to DFM principles

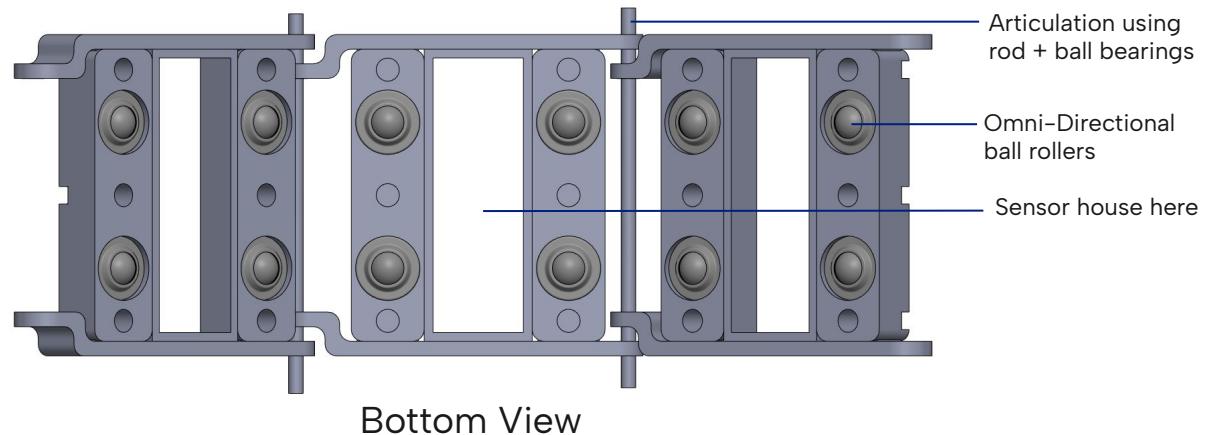


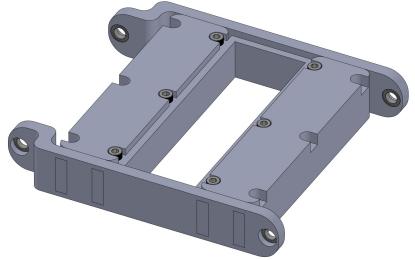
## Subcomponents

Each subcomponent is designed to be duplicated with minimal 'unique' parts

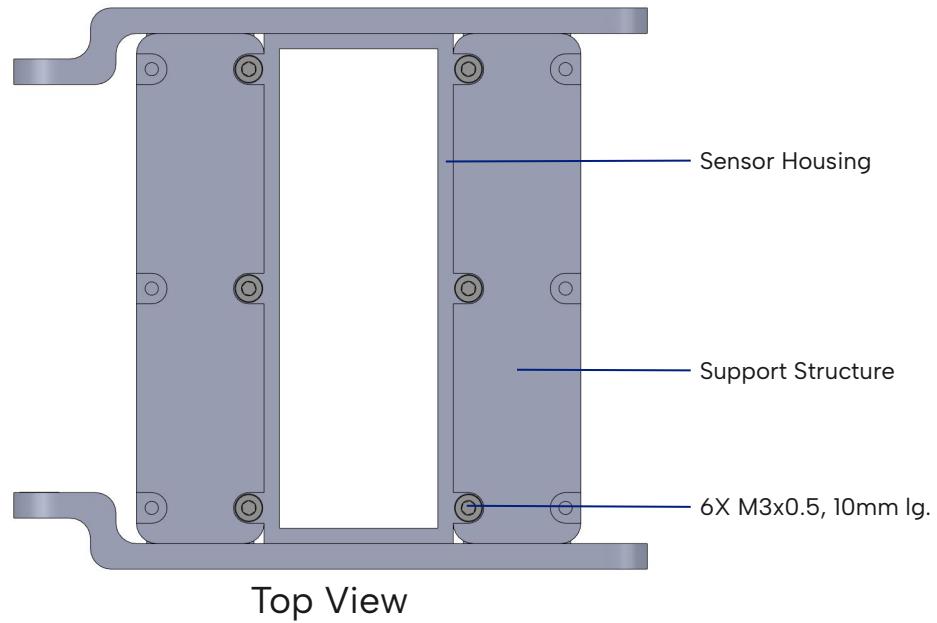


# Rev 1 Design - Full Asy



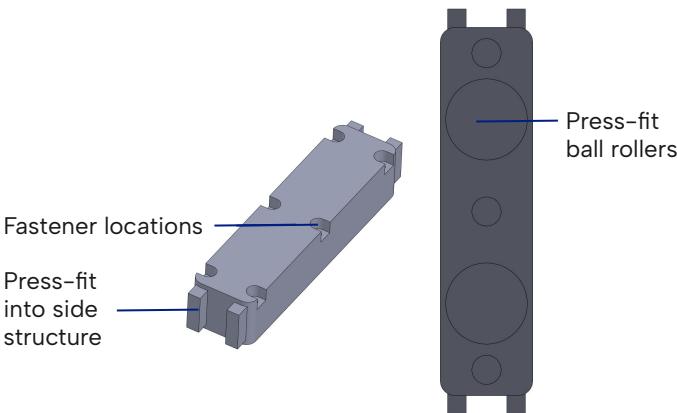
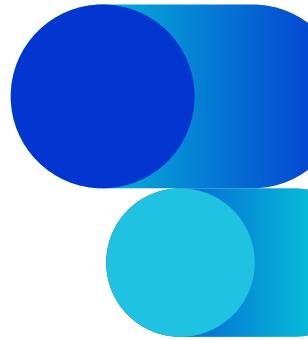


# Rev 1 Design - Module





# Rev 1 Design – Sub-components



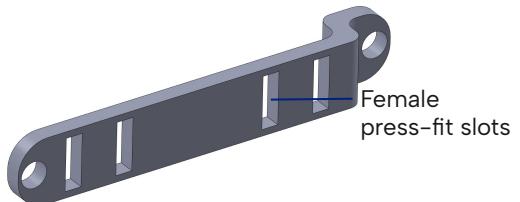
## Support Structure

Press-fit support structure with locators for fasteners and ball rollers on the bottom



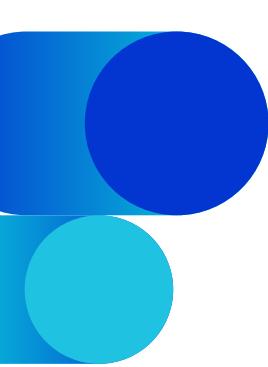
## Sensor Housing

Adapts sensors into each module and fastened by 6 fasteners



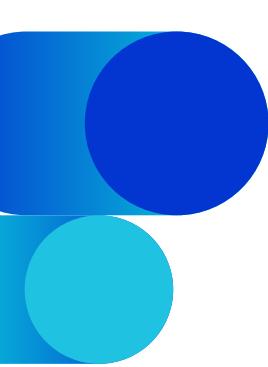
## Side Structure

Linkages inspired by bike chains with female slots to press fit with support structure



# References

- [1] Armacell, “Corrosion Under Insulation (CUI): A Global Challenge,” *White Paper*, 2019.
  - [2] NACE International, *The International Measures of Prevention, Application, and Economics of Corrosion Technologies (IMPACT) Study*, 2016.
  - [3] Omnia STS, “CUI’s Impact on Offshore Safety and Downtime,” *Industry Report*, 2023.
  - [4] Energy Capital, “Smarter CUI Inspections with Robotics Cut Cost and Time,” *Energy Capital Magazine*, vol. 12, no. 2, pp. 24–27, 2025.
  - [5] Petroleum Safety Authority Norway, “Trends in Risk Level on the Norwegian Shelf,” 2022.
  - [6] U.S. PHMSA, *Pipeline Incident Flagging and Analysis*, Office of Pipeline Safety, 2021.
  - [7] Vidya Technology, “Challenges in Offshore CUI Inspection,” *Technical Brief*, 2023.
  - [8] TÜV Rheinland, “Offshore CUI: Access and Integrity Management,” *NDT in Oil & Gas Conference Proceedings*, 2022.
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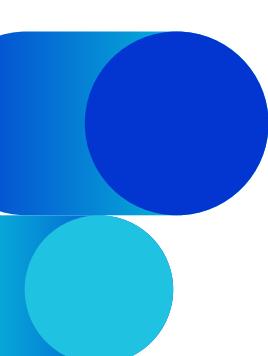
# References

- [9] Sumitomo Chemical, "Cost Drivers in CUI Inspections: Lessons from Practice," *CUI Symposium Proceedings*, 2019.
  - [10] Eddyfi Technologies, "Non-Destructive Testing for CUI in Offshore Facilities," *Application Note*, 2023.
  - [11] TE Connectivity, "Environmental Drivers of CUI: Marine and Offshore," *White Paper*, 2023.
  - [12] Armacell, "Understanding Wet Insulation and Corrosion Risk," *Insulation Engineering Digest*, 2020.
  - [13] API, *API 570: Piping Inspection Code*, American Petroleum Institute, 4th ed., 2016.
  - [14] DNV, *DNV-RP-G109: Risk-Based Management of CUI*, DNV Recommended Practice, 2021.
- 

# Template Start

Name





# Contents of this template

You can delete this slide when you're done editing the presentation

**Fonts** To view this template correctly in PowerPoint, download and install the fonts we used

**Used and alternative resources** An assortment of graphic resources that are suitable for use in this presentation

**Thanks slide** You must keep it so that proper credits for our design are given

**Colors** All the colors used in this presentation

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# Table of contents

01

## Problem vs solution

You can describe the topic of the section here

02

## Production

You can describe the topic of the section here

03

## Market & competition

You can describe the topic of the section here

04

## Business model

You can describe the topic of the section here



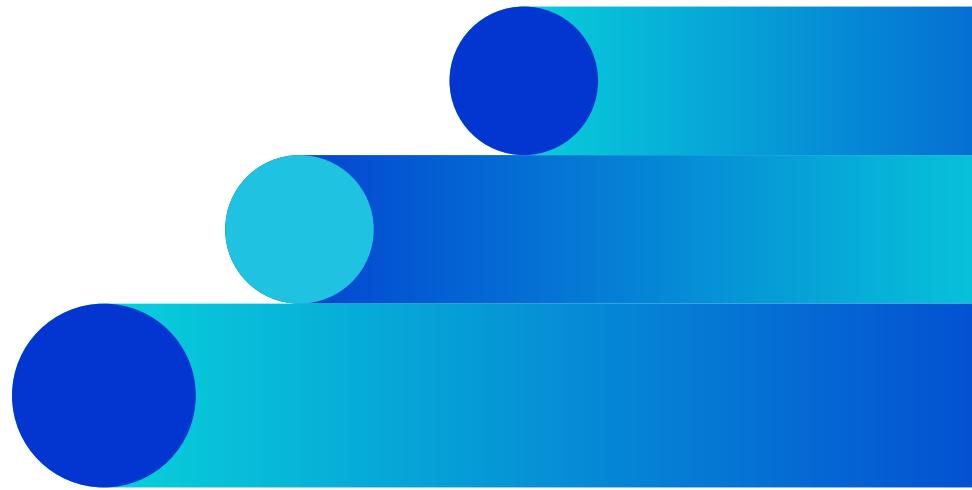
# Introduction

This can be the part of the presentation where  
you introduce yourself, write your email...



# Our company

Venus has a beautiful name and is the second planet from the Sun. It's terribly hot, even hotter than Mercury, and its atmosphere is extremely poisonous. It's the second-brightest natural object in the night sky after the Moon





01

# Name of the section

You can enter a subtitle here if you need it



# Our team



**Sofia Hill**

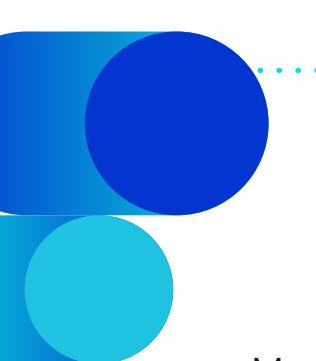
You can speak a bit about  
this person here

**John James**

You can speak a bit about  
this person here

**Jane Patterson**

You can speak a bit about  
this person here



# Do you need longer text?

Mercury is the closest planet to the Sun and the smallest one in the entire Solar System. This planet's name has nothing to do with the liquid metal, since Mercury was named after the Roman messenger god. Despite being closer to the Sun than Venus, its temperatures aren't as terribly hot as that planet's. Its surface is quite similar to that of Earth's Moon, which means there are a lot of craters and plains

Speaking of craters, many of them were named after artists or authors who made significant contributions to their respective fields. Mercury takes a little more than 58 days to complete its rotation, so try to imagine how long days must be there! Since the temperatures are so extreme, albeit not as extreme as in Venus, and the solar radiation is so high, Mercury has been deemed to be non-habitable for humans

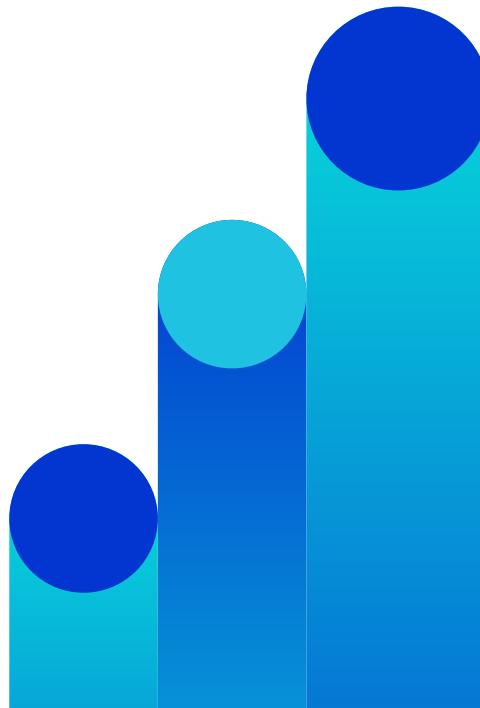


# Problem

Do you know what helps you make your point clear? Lists like this one:

- They're simple
- You can organize your ideas clearly
- You'll never forget to buy milk!

And the most important thing: the audience won't miss the point of your presentation



# Them / Us



## Them

Mercury is the closest planet to the Sun and the smallest one in the Solar System—it's a bit larger than the Moon



## Us

Venus has a beautiful name and is the second planet from the Sun. It's hot and has a really poisonous atmosphere



# Solution



## Mercury

It's the closest planet to the Sun and the smallest one



## Venus

Venus has a beautiful name and is the second planet from the Sun



## Mars

Despite being red, Mars is actually a cold place. It's full of iron oxide

# Swot analysis

## Strengths

Mars is actually a very cold place



## Weakness

Venus has extremely high temperatures



## Opportunities

Jupiter is the biggest planet of them all



## Threats

Saturn is a gas giant and has several rings



# Product overview



## Mars

Mars is actually a very cold place



## Venus

Venus has extremely high temperatures



## Neptune

Neptune is far away from us



## Mercury

It's the closest planet to the Sun



## Saturn

Saturn is a gas giant with several rings



## Jupiter

Jupiter is the biggest planet of them all

# **AWESOME WORDS**

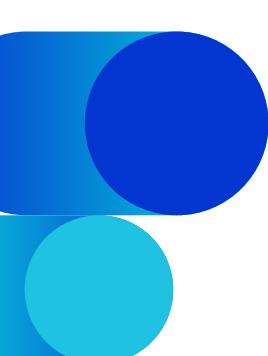
.....



“This is a quote, words full of wisdom  
that someone important said and  
can make the reader get inspired.”

—**Someone Famous**





# Our plans



\$50

## Basic

Mercury is the closest planet to the Sun



\$100

## Pro

Venus has a really beautiful name



\$200

## Premium

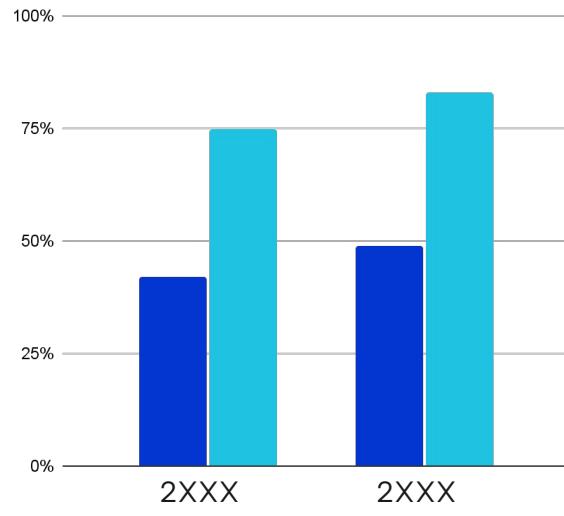
Despite being red, Mars is actually a cold place

# Product demo

You can replace the image on the screen with your own work. Just right-click on it and select "Replace image"



# Our traction



**Mars**



**Venus**



**\$243,000**

Average revenue in 2XXX



**\$142**

User savings per deal



**3,462**

Registered businesses



**78,000**

Total app downloads

Follow the link in the graph to modify its data and then paste the new one here. For more info, [click here](#)



A photograph showing a person's hands typing on a laptop keyboard. In the foreground, there is a stack of silver coins and a single lit incandescent lightbulb balanced on top of the stack. The background is blurred.

# A PICTURE IS WORTH A THOUSAND WORDS

# Case study

## Challenge

Mercury is the closest planet to the Sun and the smallest one



## Results

Venus has a beautiful name and is the second planet from the Sun



## Solution

Despite being red, Mars is actually a cold place. It's full of iron oxide



# Some reviews



## Jenna Doe

"Earth is the third planet from the Sun and the only one that harbors life in the Solar System. It's where we all live"



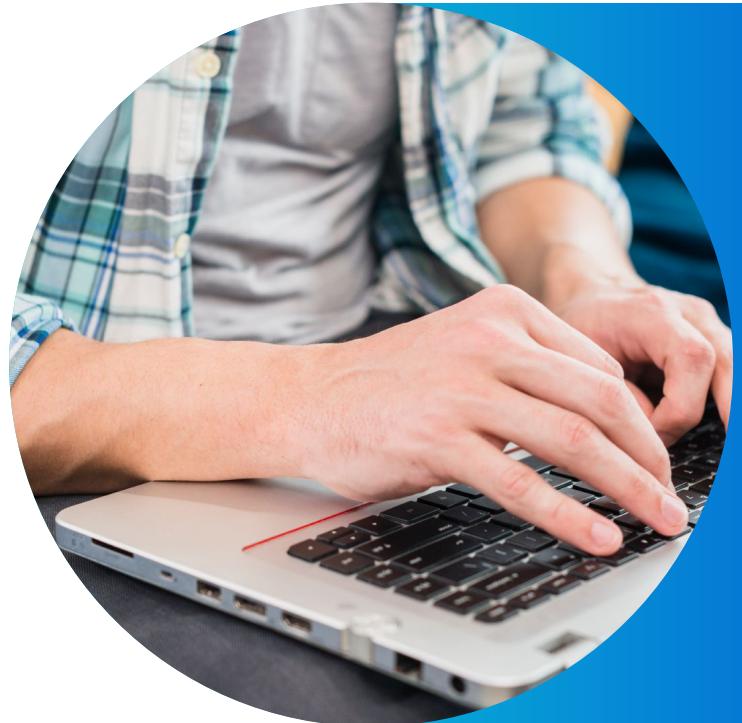
## Timmy Jimmy

"Despite being red, Mars is actually a cold place. It's full of iron oxide dust, which gives the planet its red cast"



# A picture always reinforces the concept

Images reveal large amounts of data, so remember: use an image instead of a long text. Your audience will appreciate it





.....

15,768

Big numbers catch your audience's attention

# Awards



## Mercury

Mercury is the closest planet to the Sun and the smallest one in the Solar System—it's only a bit larger than the Moon



## Venus

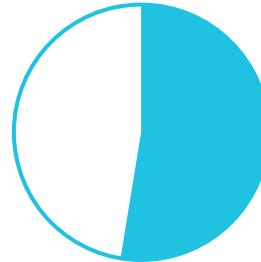
Venus has a beautiful name and is the second planet from the Sun. It's terribly hot, even hotter than Mercury



## Mars

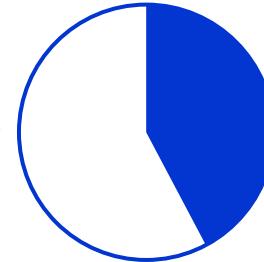
Despite being red, Mars is actually a very cold place. It's full of iron oxide dust, which gives the planet its reddish cast

# Market size



**54%**  
**Mars**

Mars is actually a very cold place



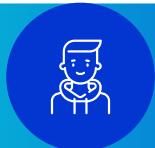
**46%**  
**Venus**

Venus has extremely high temperatures

Earth is the third planet from the Sun and the only one that harbors life in the Solar System

# Target

## Gender



**32%**

Men



**41%**

Women



**27%**

Other

## Age



**65%**

19-32



**23%**

33-47



**12%**

48-57

## Hobbies



Mars



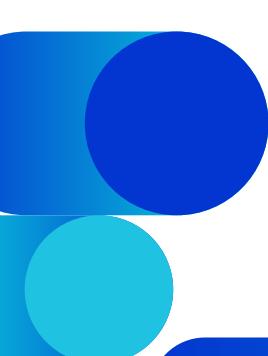
Venus



Saturn



Earth



# Competitor analysis

## Company 1

Venus has a beautiful name and is the second planet from the Sun

## Company 2

Mercury is the closest planet to the Sun and the smallest of them all

## Company 3

Earth is the third planet from the Sun and the only one that harbors life

## Company 4

Despite being red, Mars is actually a cold place. It's full of iron oxide dust

Venus

Mercury

Earth

Mars

# Business model



**Mercury**



**Marketing**

Mars is actually a very cold place



**Training**

Venus has extremely high temperatures



**Assessment**

Neptune is really far away from us



**Technology**

Saturn is a gas giant with several rings

# Project timing

Venus is the second planet from the Sun

**Day 1**



Despite being red, Mars is a very cold place

**Day 3**



**Day 2**

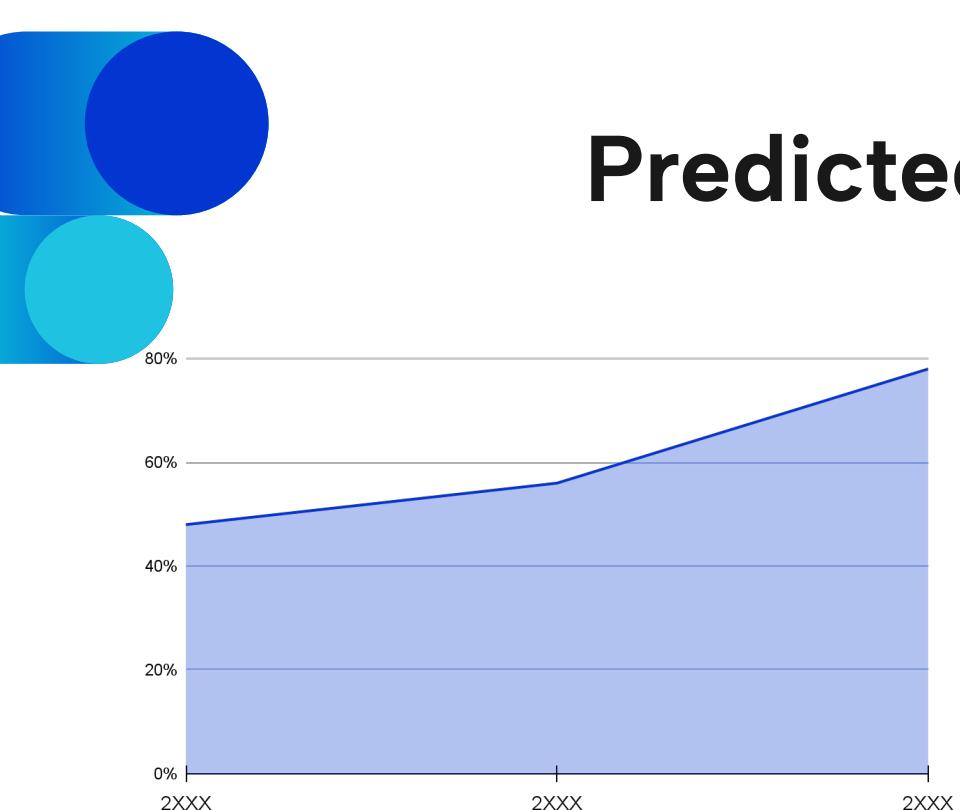
Mercury is the closest planet to the Sun



**Day 4**

Jupiter is the biggest planet of them all





# Predicted growth

From 2XXX-2XXX

Venus has a beautiful name and is the second planet from the Sun. It's terribly hot, even hotter than Mercury, and its atmosphere is extremely poisonous

Follow the link in the graph to modify its data and then paste the new one here. For more info, [click here](#)

**100**

New employees

**\$20,000**

Expected income

# Investment

25%

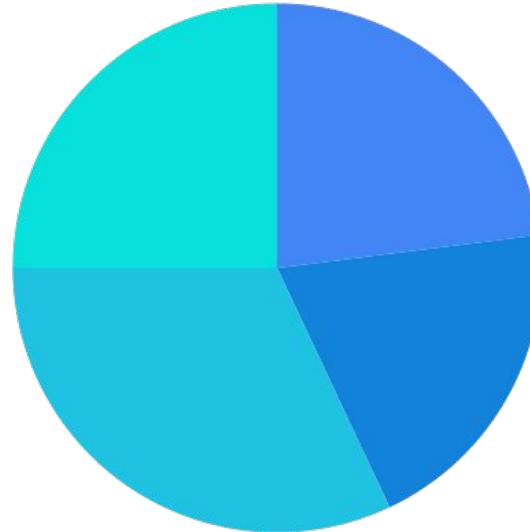
**Mars**

Mars is actually a very cold place

32%

**Mercury**

It's the closest planet to the Sun



Follow the link in the graph to modify its data and then paste the new one here. [For more info, click here](#)

23%

**Venus**

Venus has extremely high temperatures

20%

**Saturn**

Saturn is a gas giant with several rings

# Thanks!

**Do you have any questions?**

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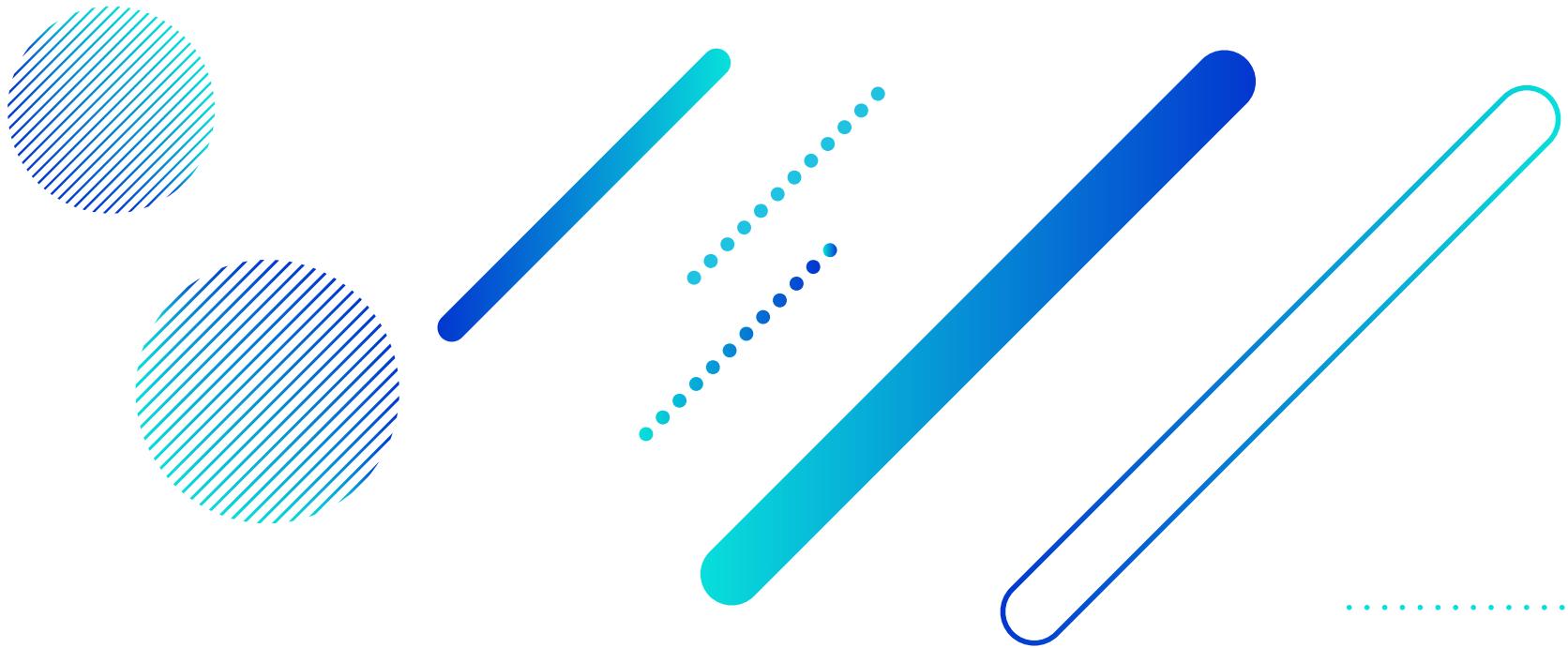


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# Alternative resources

Here's an assortment of alternative resources whose style fits that of this template:

- Abstract style classic blue background



# Resources

Did you like the resources on this template? Get them for free at our other websites:

## Vectors

- Abstract style classic blue background

## Photos

- Man cutting the stack of coins
- Freelance worker using laptop
- Nomad woman traveling with family
- Smiling young male it technician with hardware equipment's
- Young woman wearing embroidered shirt
- Top view finance elements with white piggy bank

## Icons

- Icon Pack: Crowdfunding | Lineal



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# Fonts & colors used

This presentation has been made using the following fonts:

**Albert Sans**

(<https://fonts.google.com/specimen/Albert+Sans>)

#191919

#ffffff

#002080

#03336d0

#1382db

#1fc2e1

#08e0db

#03fcd5

# Storyset

Create your Story with our illustrated concepts. Choose the style you like the most, edit its colors, pick the background and layers you want to show and bring them to life with the animator panel! It will boost your presentation.  
Check out [how it works](#).



Pana



Amico



Bro



Rafiki



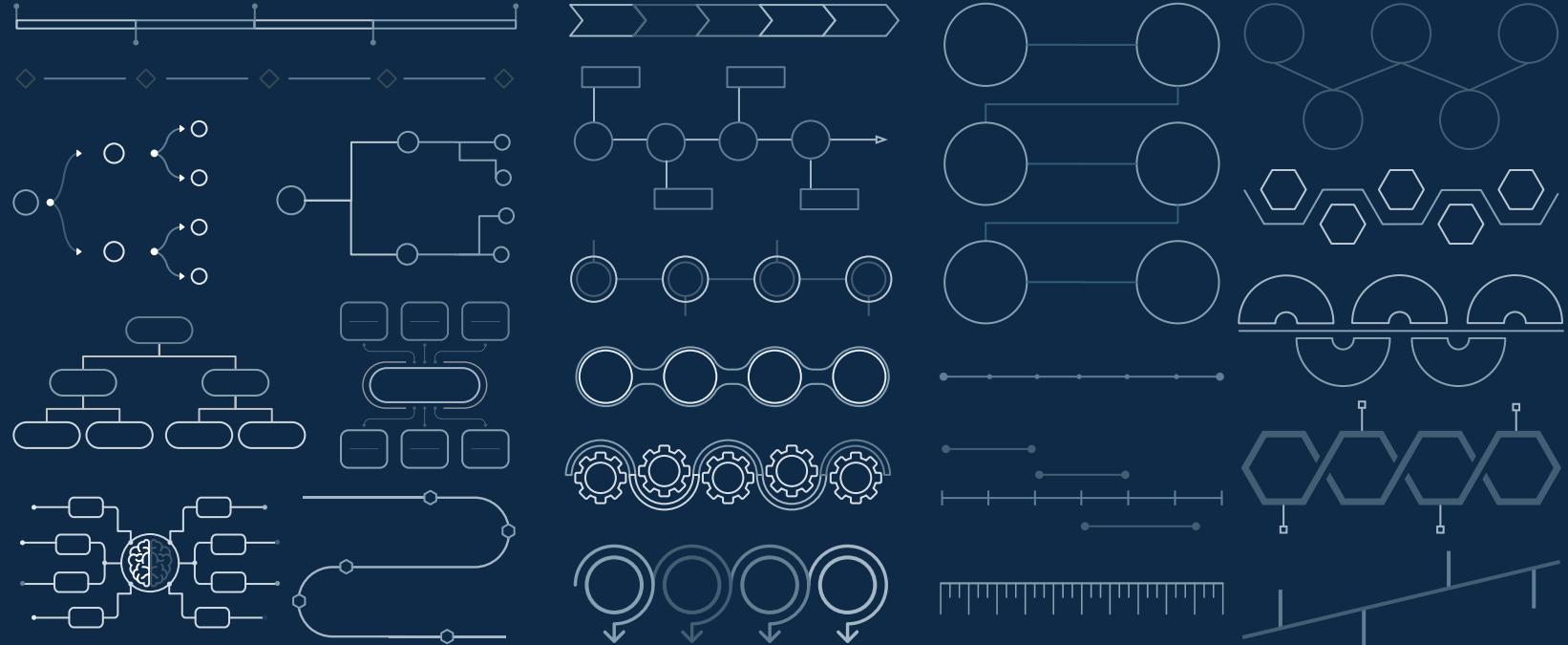
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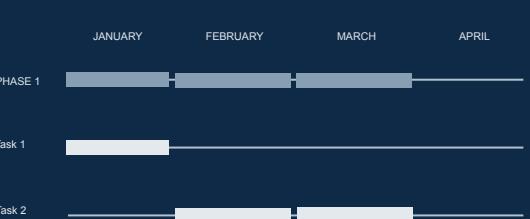
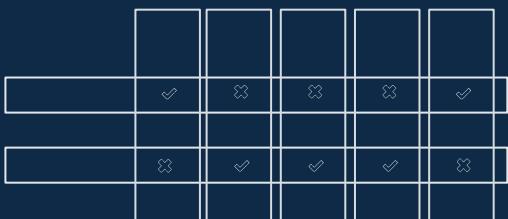
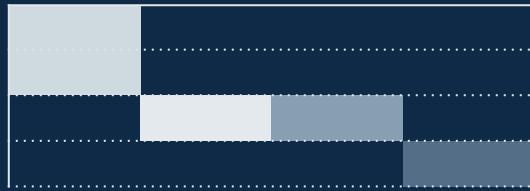
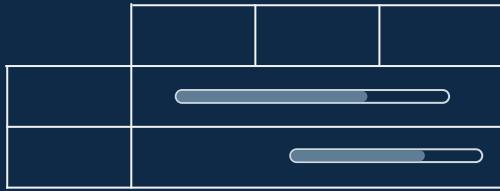
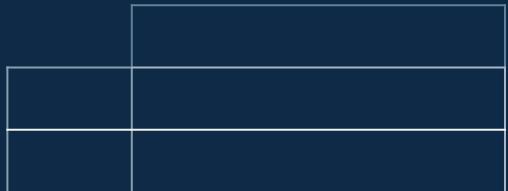
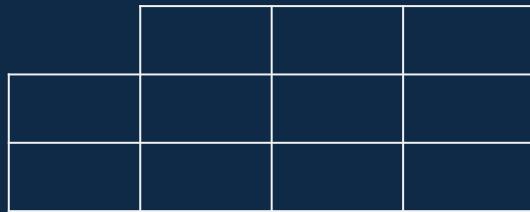
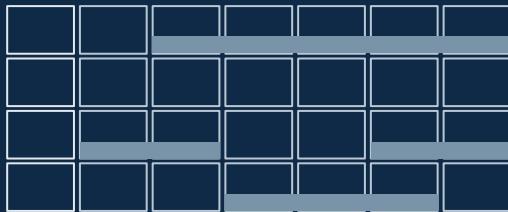
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You can easily **resize** these resources without losing quality. To **change the color**, just ungroup the resource and click on the object you want to change. Then, click on the paint bucket and select the color you want. Group the resource again when you're done. You can also look for more **infographics** on Slidesgo.

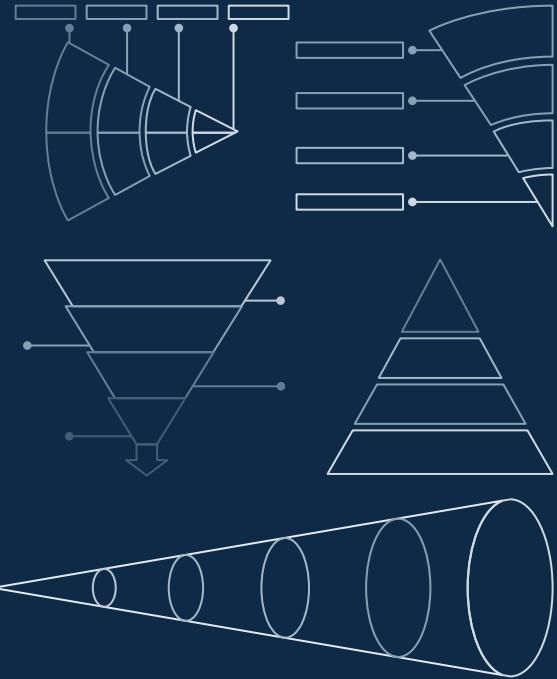
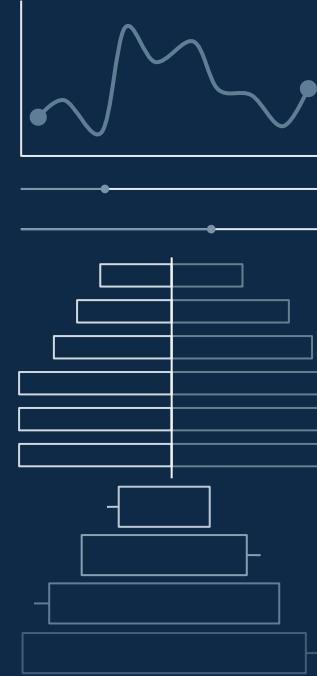
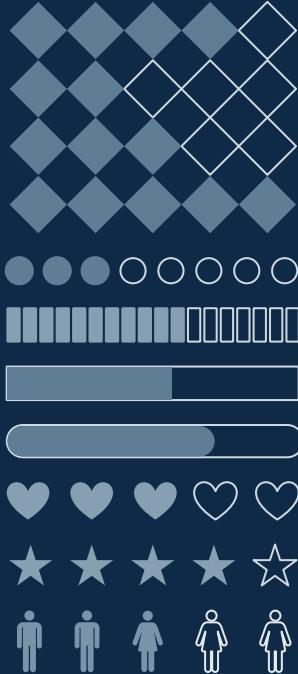
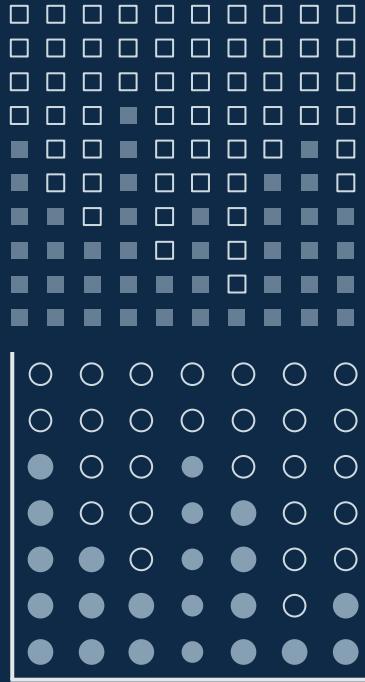












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# Medical Icons



# Business Icons



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