

A decorative pattern of white-outlined squares of various sizes is scattered across the blue background. Some squares are arranged in vertical columns on the left side, while others are more isolated in the upper and lower portions of the slide.

# Flexible Thread Technology

A series of white-outlined squares of various sizes are arranged in a decorative pattern along the left and top edges of the slide. On the left, there is a vertical column of squares, with some smaller squares interspersed. Along the top, several squares are spaced out, with one notably smaller square positioned towards the center.

# Meeting Objectives

- Introductions
- Flexible Thread Technology Development and History
- Features and Benefits of Flexible Thread Technology
- Applications Utilizing Flexible Thread Technology
- Business Model
- Conclusion



# Introductions

- ***Bob Fullerton:*** Chief Innovator and inventor of the Flexible Thread Technology
- ***ANI Solutions:*** Manufacturing, sales, and marketing strategists



# History of the Flexible Thread Technology

- Development stages of a successful invention:
  - Typical “development timeline” is measured in trimesters
    - **1<sup>st</sup> trimester:** develop a functioning product (to solve a problem or fill a need)
    - **2<sup>nd</sup> trimester:** design for economical repeatability
    - **3<sup>rd</sup> trimester:** design for the intended market economics



## History (cont.)

- 1979
  - Fullerton perceives a need when watching auto racing
  - patents applied for
- 1993
  - first iteration patents issued (ZipNut®)
  - successful completion of 1st trimester (develop a functioning product)

**CHANGE RECORD**

| REV. | DATE | DESCRIPTION |
|------|------|-------------|
| 1    |      |             |

**GENERAL NOTES**  
UNLESS OTHERWISE SPECIFIED:

- INTERPRET DIMENSIONING AND TOLERANCING PER ASME Y14.3M-1994.
- BREAK SHARP EDGES .003-.015 CHAMFER OR RADIUS, UNLESS OTHERWISE SPECIFIED.
- ALL MACHINED SURFACE ROUGHNESS 125 MICRONS INCHES PER ANSI B46.1-1985 UNLESS OTHERWISE STATED.
- POSTS OF ITEM 4 MUST ALIGN IN NOTCHES OF ITEM 2.
- ITEM 4 SNAPS INTO ITEM 1 FOR FINAL INSTALLATION.
- SEGMENTS OF ITEM 2 MUST BE POSITIONED SUCH THAT THREADS ARE ALIGNED WITH THREADS OF ADJACENT SEGMENTS.

**SECTION A-A**  
SCALE 4:1

**FOR ENGINEERING REFERENCE ONLY**  
SCALE NONE

**FULLERTON DESIGN**  
P.O. Box 4110  
INCLINE VILLAGE, NEVADA 89450

**MDA ZIP NUT -**  
**.5000-20 UNJF-3B**

**ZN10200**

**-08 ASSY**



## History (and Disclosure) - *Two Diverging Paths*

- 
- 1991: ZipNut®
    - patents/intellectual property taken from Fullerton in a lawsuit filed by the State of Nevada (filing was in response to actions taken by Fullerton's attorney)
  - 1991 - current
    - ZipNut® was taken over by the attorney
    - product was brought to market, but with quality and manufacturing issues
- 
- 



## *Two Diverging Paths (cont.)*

- 1991 - 2009: Bob Fullerton
    - defends his rights to patents and intellectual property
  - 2009
    - case is finally settled as a single “no contest” misdemeanor count - misfiling of documents
    - original ZipNut® remains with attorney
  - 2009 - current
    - third design iteration of the Flexible Thread Technology completed with enhanced performance benefits (not in conflict with any existing patents; patents pending)
- 



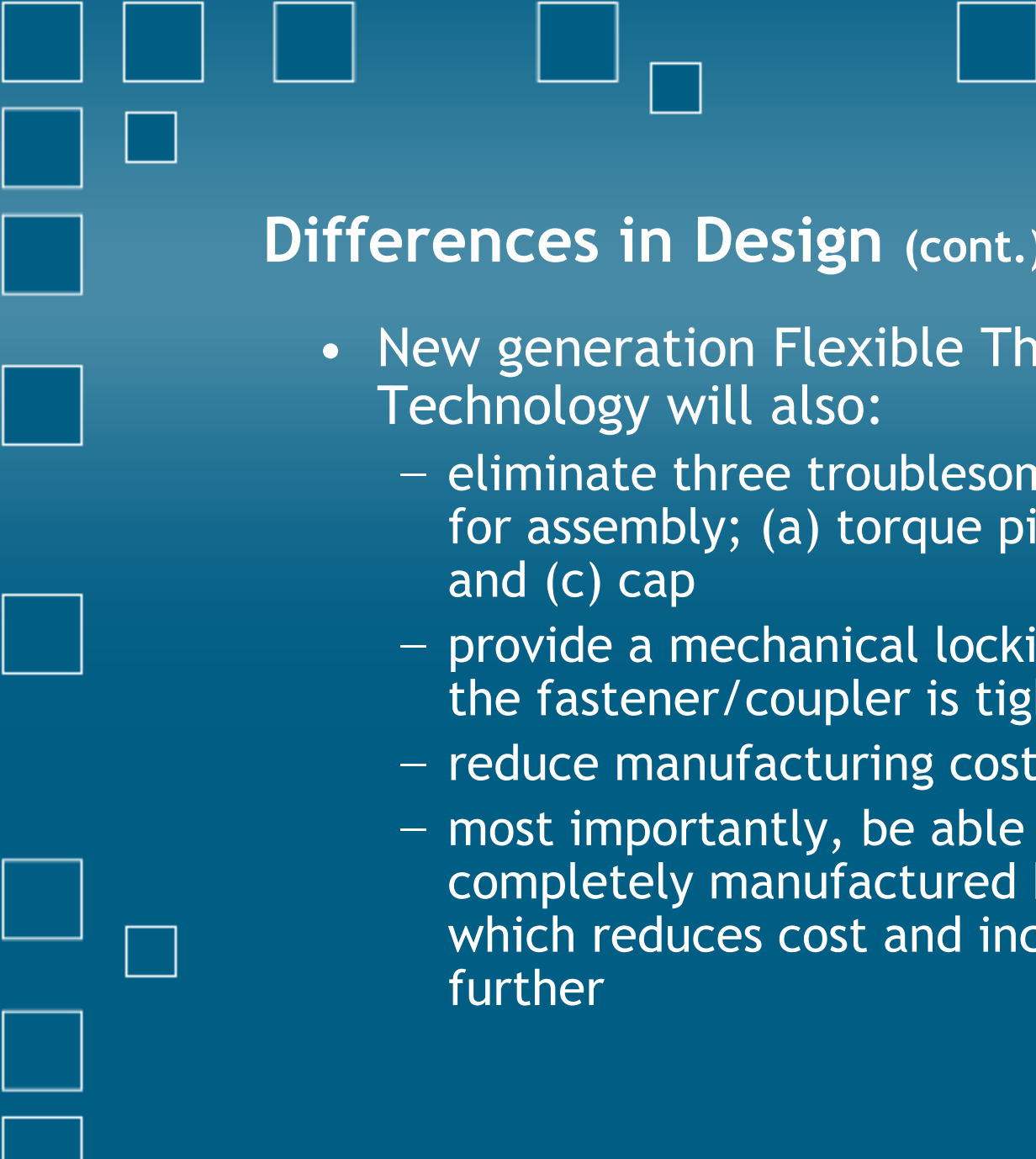
## Differences in Design

- Differences of original ZipNut® and the new generation Flexible Thread Technology are as follows:
  - Original ZipNut®, functioned fairly well, but proved difficult to maintain quality control of critical internal dimensions and challenging in providing repeatability
  - Resulting product was very expensive to manufacture



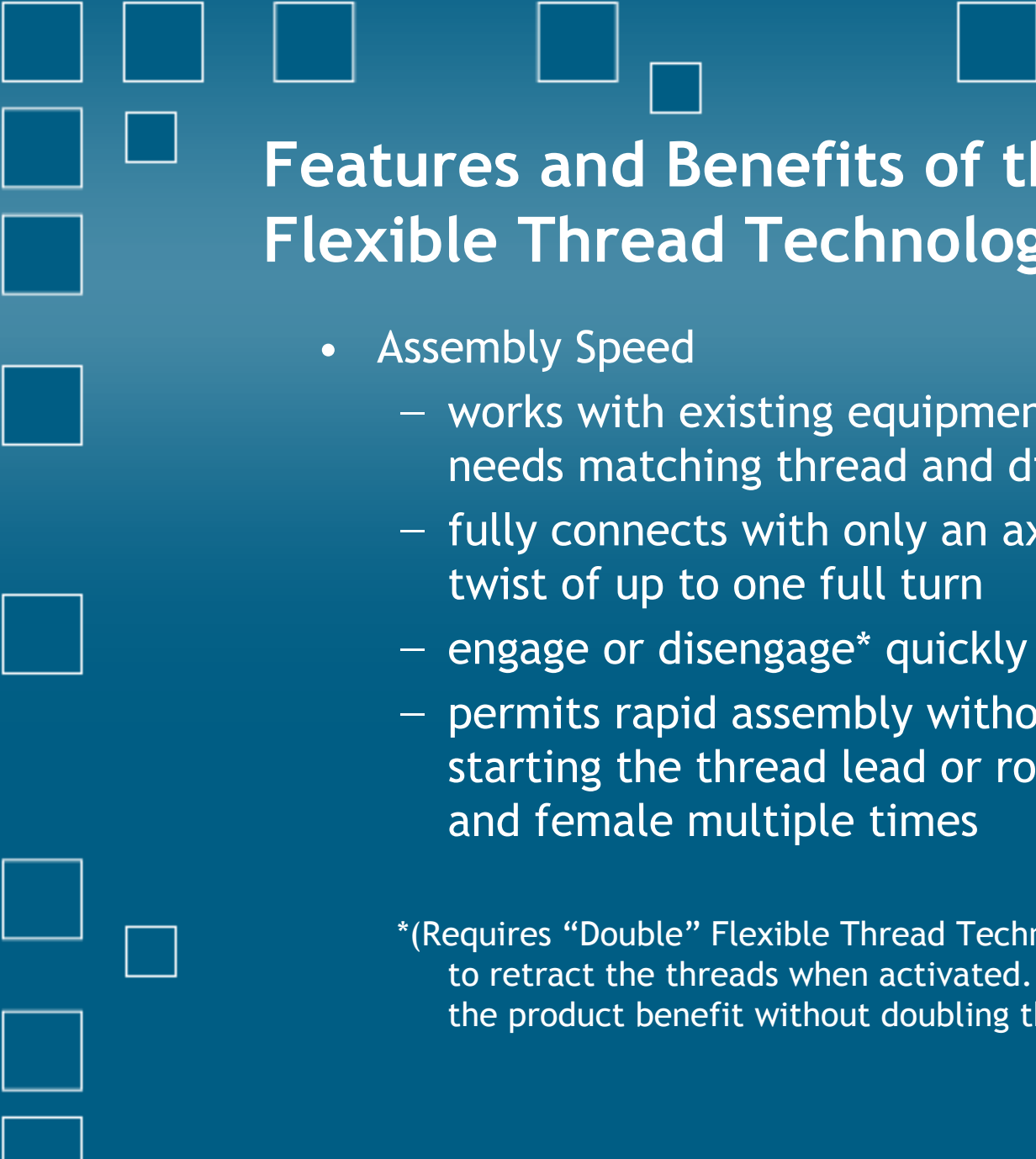
## Differences in Design (cont.)

- New generation Flexible Thread Technology maintains the centerline of the thread segments, with respect to the internal dimensions of the outer body
- Critical to both quality and repeatability
- Resulting product is cost-effective to manufacture

A series of white-outlined squares of various sizes are arranged in a grid-like pattern on the left side of the slide. There are 18 squares in total, with some being larger than others, creating a decorative border.

## Differences in Design (cont.)

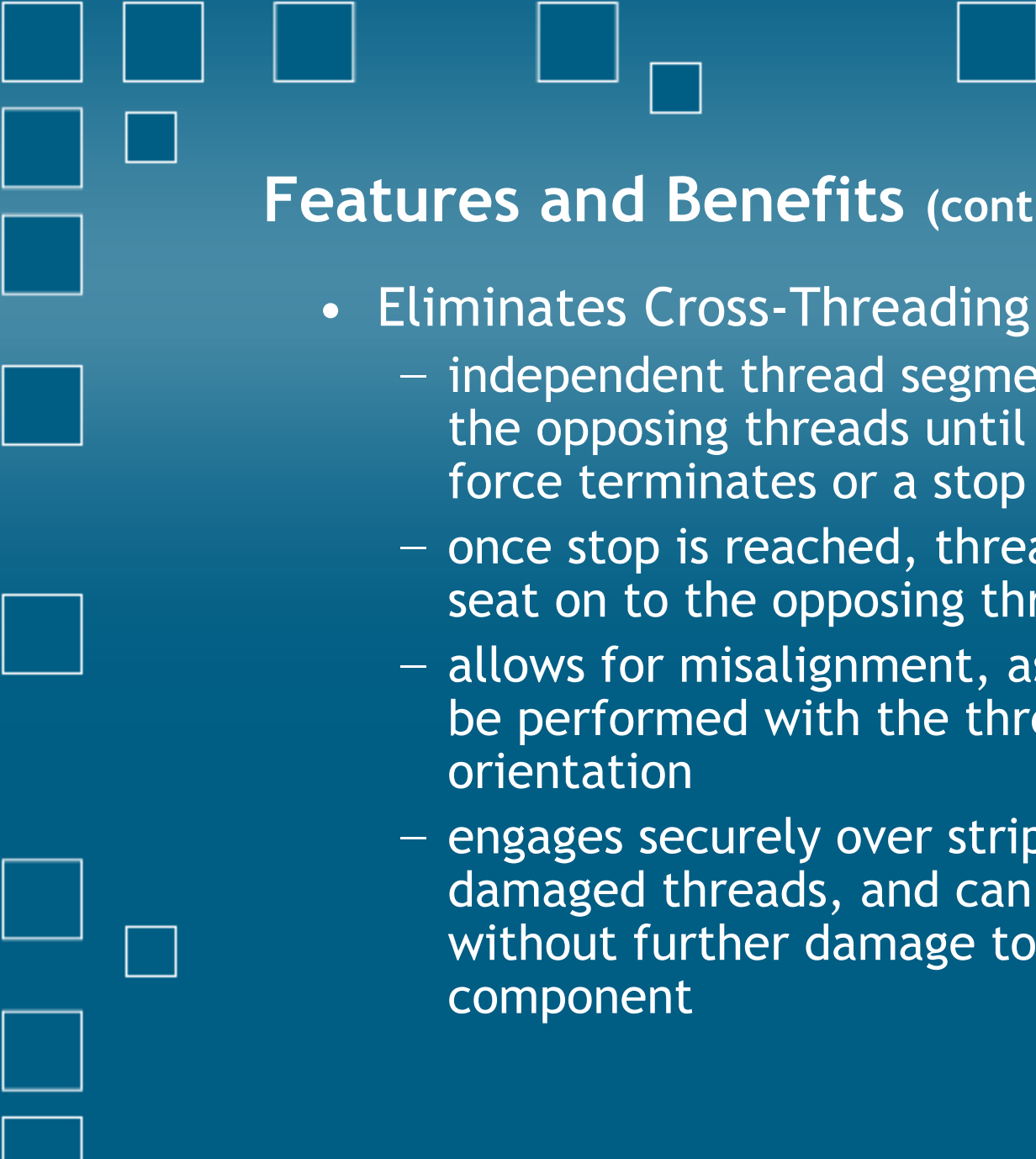
- New generation Flexible Thread Technology will also:
  - eliminate three troublesome components for assembly; (a) torque pins, (b) springs, and (c) cap
  - provide a mechanical locking effect when the fastener/coupler is tightened
  - reduce manufacturing costs by up to 30%
  - most importantly, be able to be completely manufactured by automation which reduces cost and increases quality further

A series of white-outlined squares of various sizes are arranged in a vertical column on the left side of the slide. Some squares are solid white, while others are hollow. They are positioned at different heights, creating a decorative border.

# Features and Benefits of the New Flexible Thread Technology

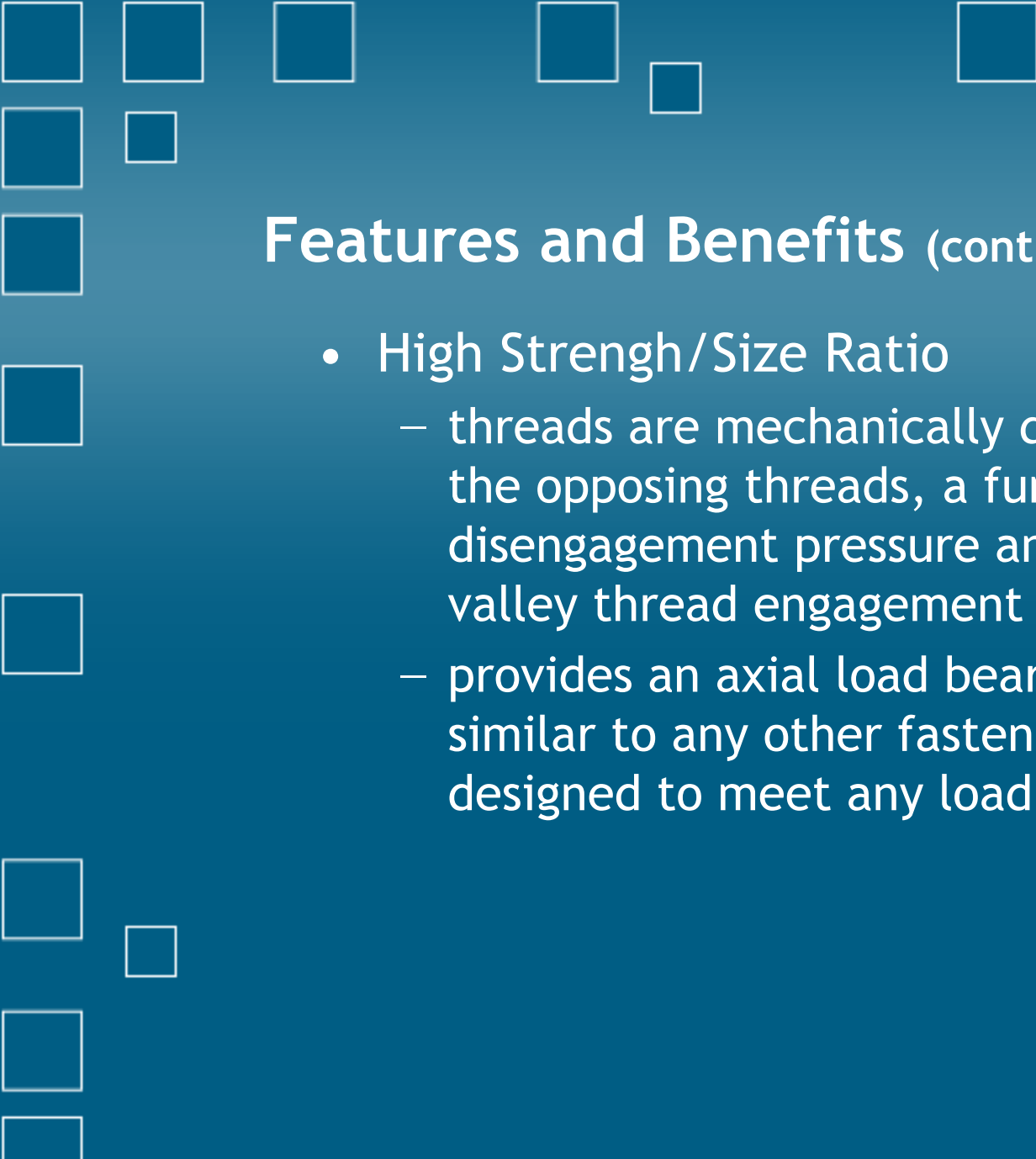
- Assembly Speed
  - works with existing equipment; male only needs matching thread and diameter
  - fully connects with only an axial push and twist of up to one full turn
  - engage or disengage\* quickly
  - permits rapid assembly without the need of starting the thread lead or rotating the male and female multiple times

\*(Requires “Double” Flexible Thread Technology which is designed to retract the threads when activated. This feature doubles the product benefit without doubling the cost.)

A series of white-outlined squares of various sizes are arranged in a grid-like pattern on the left side of the slide. There are four columns of squares. The first column has six squares, the second has two, the third has one, and the fourth has one. The squares are of different sizes, with some being larger than others.

## Features and Benefits (cont.)

- Eliminates Cross-Threading
  - independent thread segments slide over the opposing threads until either the axial force terminates or a stop is reached
  - once stop is reached, thread segments seat on to the opposing threads
  - allows for misalignment, as axial push can be performed with the thread leads at any orientation
  - engages securely over stripped or damaged threads, and can be removed without further damage to either component

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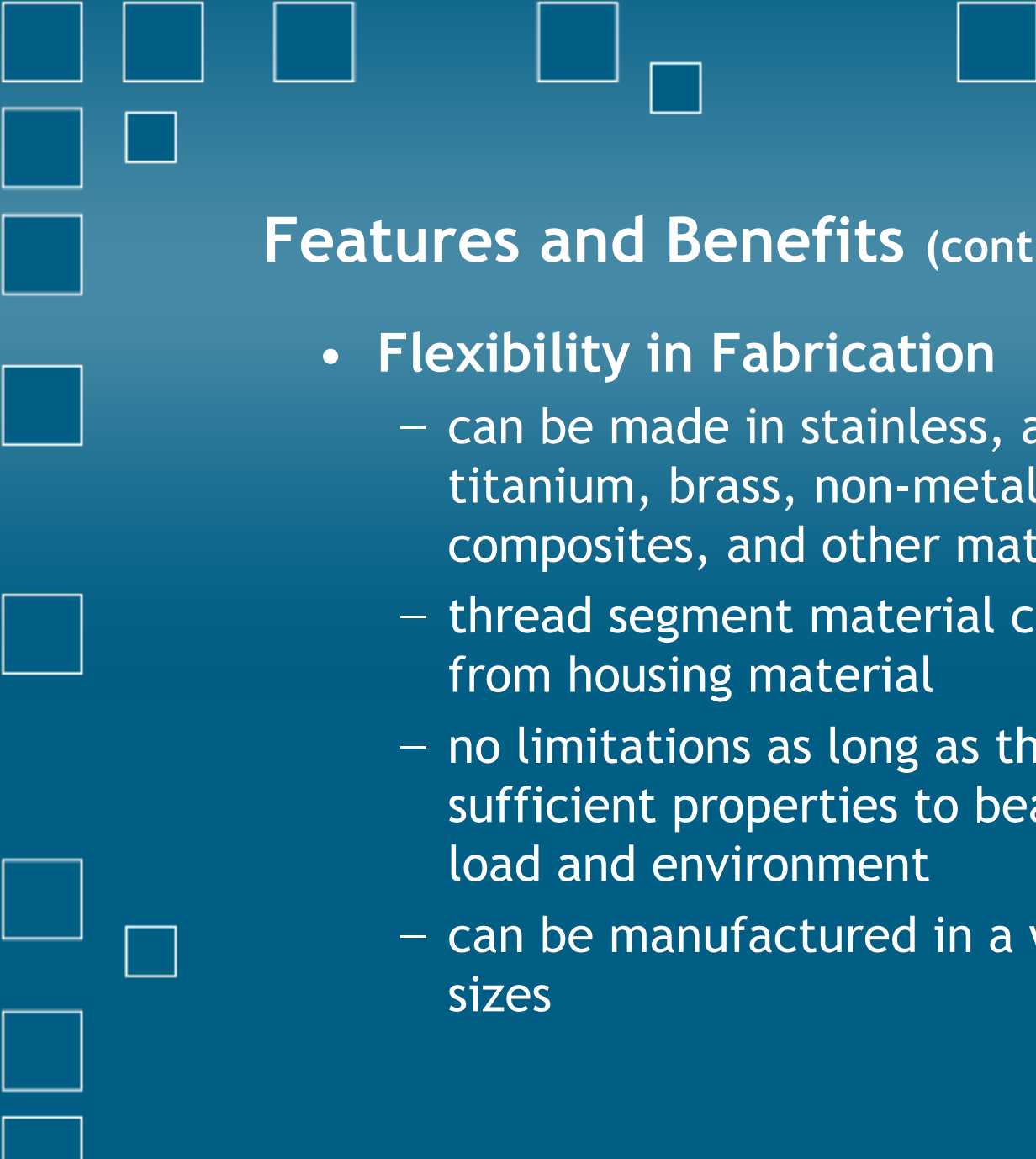
## Features and Benefits (cont.)

- High Strength/Size Ratio
  - threads are mechanically drawn against the opposing threads, a function of disengagement pressure and 100% peak-to-valley thread engagement
  - provides an axial load bearing capability similar to any other fastener that can be designed to meet any load requirements



## Features and Benefits (cont.)

- **Resists Movement under Vibration**
  - mechanical interlock design operates to lock the threads in place and prevents movement during vibration

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## Features and Benefits (cont.)

- **Flexibility in Fabrication**

- can be made in stainless, aluminum, titanium, brass, non-metallics, composites, and other materials
- thread segment material can be different from housing material
- no limitations as long as the material has sufficient properties to bear the specified load and environment
- can be manufactured in a wide range of sizes



## Features and Benefits (cont.)

- **Other Essential Benefits for Use:**
  - in harsh environmental conditions (outer space, weather, etc.)
  - in difficult physical circumstances (confined space, awkward load or configuration, etc.)
  - where reliability of connection is required under high loads or pressure
  - where threads are otherwise unavailable (robotics)
  - where damaged threads are a problem



# Applications where Flexible Thread Technology is in Use

- The International Space Station
  - Boeing
    - Main Truss Structural Joints
    - EVA Soft/Hard Dock and Airlock Orbital Replacement Units
    - Universal Trunnion Attachment System
    - Robotic Assembly Deployment of UHF Antenna Booms
  - Honeywell
    - Alpha & Beta Solar Panel Gimbals
  - Rocketdyne
    - Solar Array Mast Canister

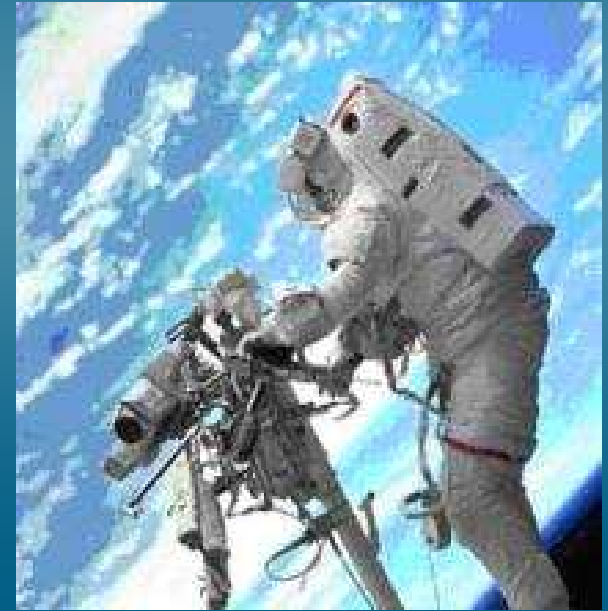


## Applications (cont.)

- NASA Shuttle Repair Missions
    - Swales Aerospace
      - Hubble Space Telescope Repair Mission for Goddard Space Flight Center
      - Repair and Servicing Missions in 1993, 1997, 1999, and 2009 which included:
        - Wide Field and Planetary Camera
        - Fine Guidance Sensor
        - Solar Array Drive
        - Data Interface Unit
        - S-Band Single Access Transmitter
- 
- 
- 
- 
- 

## Applications (cont.)

ZipNuts® have been used in  
the servicing of the Hubble  
Space Telescope  
[Dec. 1999 mission - right]  
Image credit: NASA





## Highlights of NASA Applications

- NASA has incorporated Flexible Thread Technology as a “Recommended Technique for Effective Maintainability in Selection of Robotically Compatible Fasteners and Handling Mechanisms” (Technique DFE-l) in its official Policy for Safety and Mission Success (NPD 8700. 1)
  - Official Design Factors for all future NASA projects specifically recommend the Flexible Thread technology to “avoid jamming and binding” and as an “excellent soft dock attachment”
- 



## Applications (cont.)

- Power and Energy
    - Carolina Power & Light / Tennessee Valley Authority
      - to seal the heat exchanger, preventing reactor water from entering during scheduled power outages
    - U.S. Department of Energy
      - to permanently attach circulation fans at the Savannah River Project
    - Florida Power & Light
      - to attach ducting during nuclear power outages
- 
- 



## Applications (cont.)



- Deep-Water Construction



- FMC

- used on a deep-water pipe-laying machine



- Sonsub

- used on a deep-water pipe-laying remote operated vehicle (ROV), “BRUTUS”



- Manufacturing



- Goodyear

- used to attach molds to tire manufacturing equipment



- Jergens

- used to automatically proof load ever swivel bolt they sell



## Applications (cont.)

- Other Uses Include:
  - Production of high-pressure gas cylinders
    - Air Products, AGA, Airgas, Holox (Linde) and BOC (Linde)
  - Fire and Rescue equipment
    - Curtiss- Wright and Power Hawk Technologies
  - Medical equipment
    - Nellcor Puritan Bennett

# Business Model

**The Business Model Canvas**

Designed for: \_\_\_\_\_ Designed by: \_\_\_\_\_

On: \_\_\_\_\_ Date: \_\_\_\_\_

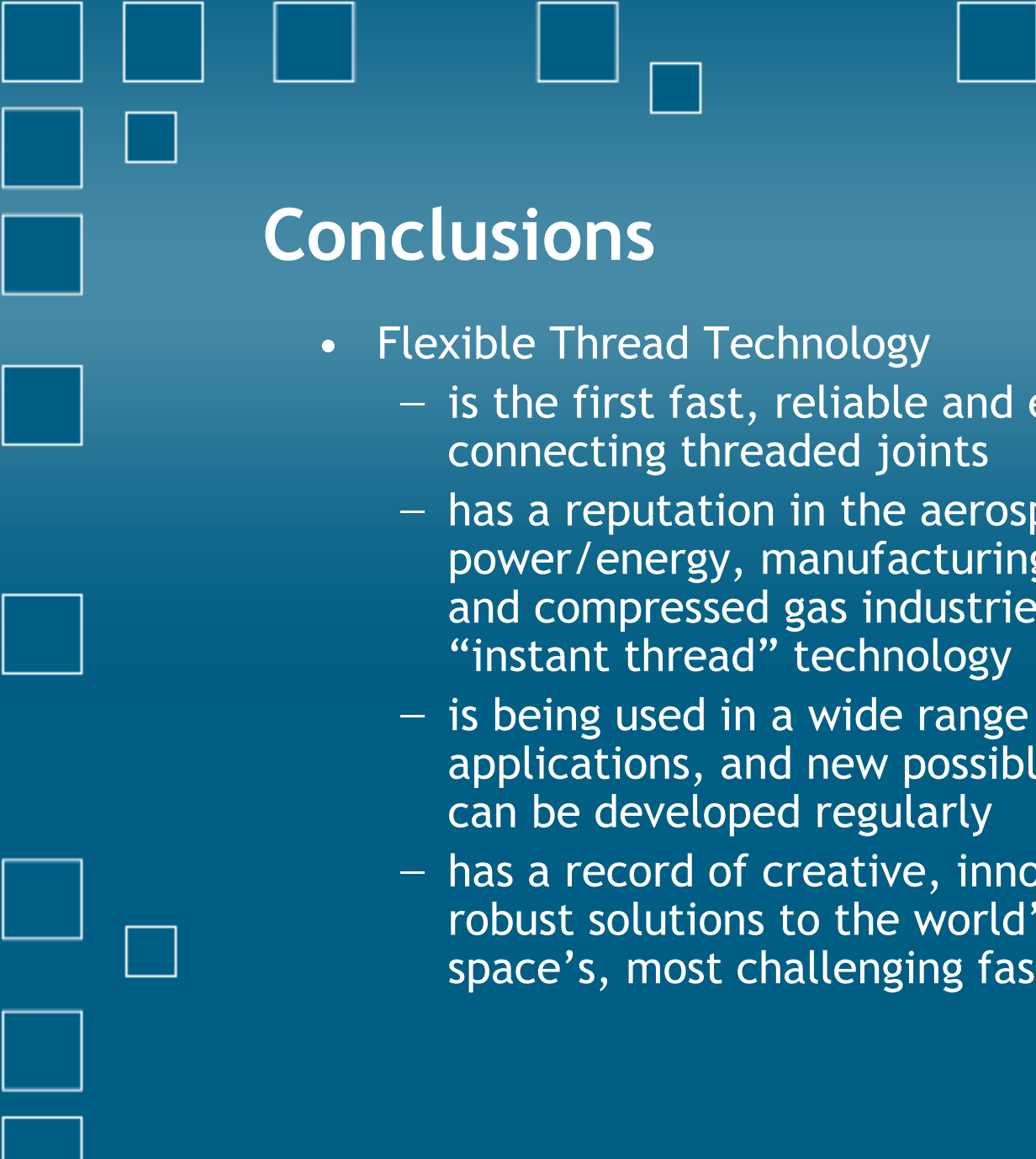
Iteration: \_\_\_\_\_

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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Key Partners</b><br><br>Why are we key partners?<br>What are we key suppliers?<br>What new resources are we acquiring from partners?<br>Which key Activities do partners perform?<br>Which key Channels do partners perform?<br>Which key Revenue Streams do partners perform? | <b>Key Activities</b><br><br>What key Activities do we do?<br>What key Resources do we need?<br>What key Channels do we need?<br>What key Revenue Streams do we need? | <b>Value Propositions</b><br><br>What value do we deliver to the customer?<br>What is new or better about our Value Proposition?<br>What benefits, if any, do we offer to the customer?<br>Which customer needs are we satisfying?                                                                           | <b>Customer Relationships</b><br><br>What type of relationship does each of our Customer Segments expect us to establish and maintain with them?<br>Which customer needs are we satisfying?<br>How are they interacting with the rest of our business model?<br>How costly are they? | <b>Customer Segments</b><br><br>For whom are we creating value?<br>Who are our most important customers?<br>How many are there?<br>How are they interacting with the rest of our business model? |
| <b>Key Resources</b><br><br>What key Resources do we need to deliver our Value Proposition?<br>What key Channels do we need?<br>What key Revenue Streams do we need?                                                                                                              |                                                                                                                                                                                                                                                        | <b>Channels</b><br><br>Through which Channels do our Customer Segments want to be reached?<br>How are we reaching them now?<br>How are our Channels changing?<br>Which ones are most cost-efficient?<br>Which ones are most cost-effective?<br>How are they interacting with the rest of our business model? |                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                     |
| <b>Cost Structure</b><br><br>What are the most important costs incurred in our business model?<br>Which key Resources are most expensive?<br>Which key Activities are most expensive?<br>Which key Channels are most expensive?                                               |                                                                                                                                                                                                                                                        | <b>Revenue Streams</b><br><br>For what value are our customers really willing to pay?<br>For what do they currently pay?<br>How are they currently paying?<br>How would they prefer to pay?<br>How much does each Revenue Stream contribute to overall revenues?                                           |                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                     |

www.businessmodelgeneration.com

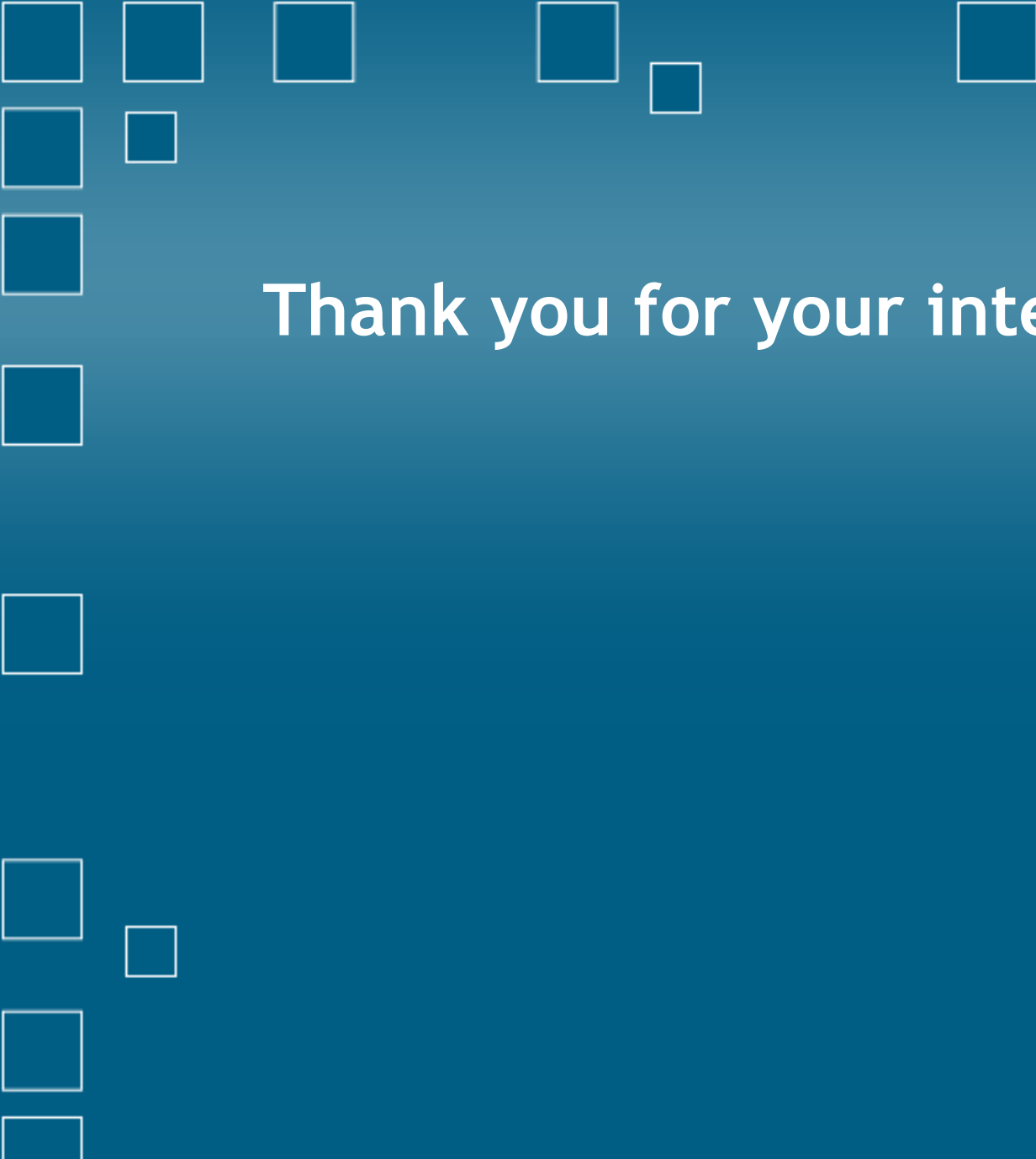
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-Business Model Canvas - provided at [www.businessmodelgeneration.com](http://www.businessmodelgeneration.com)

A series of white-outlined squares of various sizes are arranged in a grid-like pattern on the left side of the slide. Some squares are solid blue, while others are white with a blue outline. They are positioned at the top, along the left margin, and at the bottom.

# Conclusions

- Flexible Thread Technology
  - is the first fast, reliable and easy method of connecting threaded joints
  - has a reputation in the aerospace, power/energy, manufacturing, fire/rescue, and compressed gas industries as the first “instant thread” technology
  - is being used in a wide range of different applications, and new possible applications can be developed regularly
  - has a record of creative, innovative, and robust solutions to the world’s, and outer space’s, most challenging fastener problems

The slide features a dark blue background with a light blue gradient. On the left side, there is a vertical column of ten white-outlined squares. The first four squares are solid dark blue, while the remaining six are white outlines. Additionally, there are several other white-outlined squares scattered across the top and middle of the slide, some of which are also solid dark blue. The text "Thank you for your interest!" is centered in a white, sans-serif font.

Thank you for your interest!