



**34<sup>th</sup>** Annual **INCOSE**  
international symposium

hybrid event

Dublin, Ireland  
July 2 - 6, 2024



# A Case Study of AI Usage Within the INCOSE Technical Process

2-6 July 2024

[www.incose.org/symp2024](http://www.incose.org/symp2024) #INCOSEIS



# Agenda



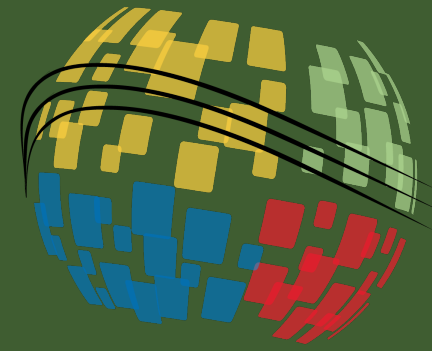
BACKGROUND



CASE STUDY



RESULTS

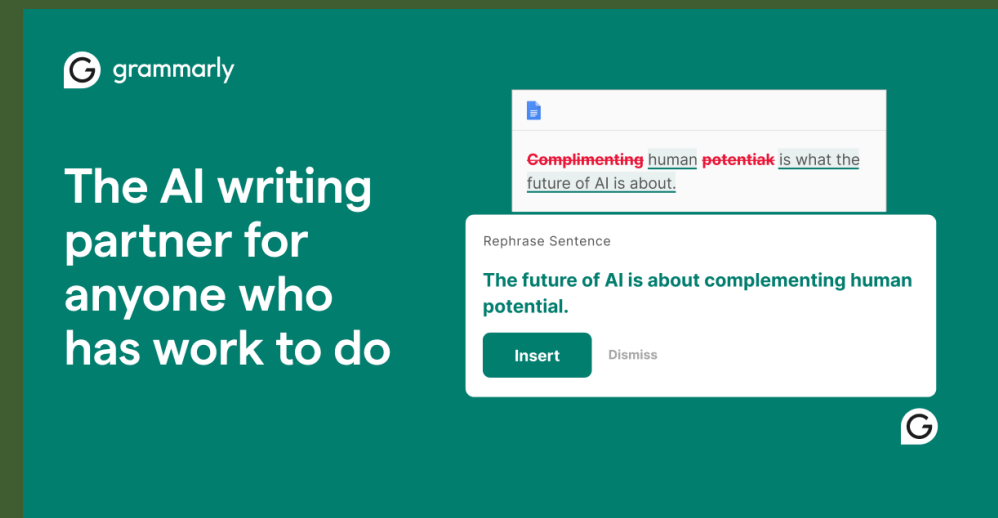
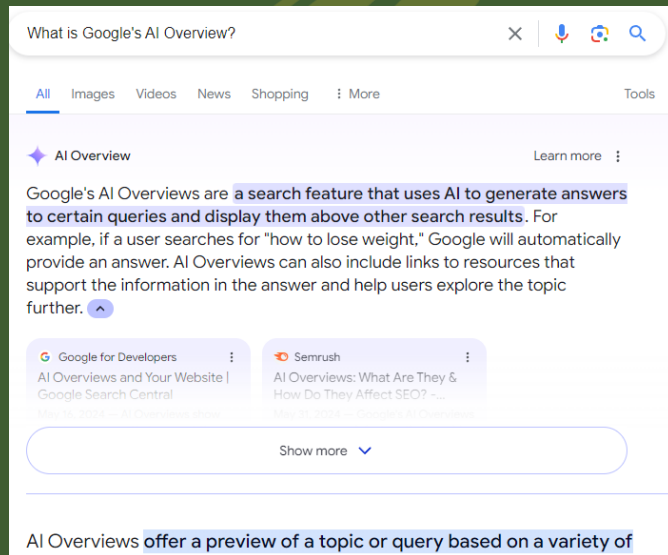


# Background

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# Artificial Intelligence

- ChatGPT released its demo to the public on November 30, 2022.
  - By end of its first month up, it had 266 million visits.



# Research Questions:



1. Can engineers or anyone working in systems engineering use AI to help develop new or improved system development projects?
2. Do available AI platforms vary significantly based on similar prompts?
3. Which stages of the INCOSE Technical Process are best and least suited for AI implementation?
4. Can prompts provided to AI be “engineered” for some or all of the steps in the INCOSE technical process? If so, what would the prompts/templates look like? If not, why does a prompt/template not work?
5. If a past product development course project is used as a test case, how does the AI platform complete the various INCOSE Technical Process steps compared to the human team?
6. What recommendations can be provided to any individual or team embarking on a new/improved system engineering effort regarding how to best utilize AI?

# Use Case Foundation: Project Setup

Class Project: Follow a process from coming up with a pain point to pitching that idea in one semester using various tools introduced.

Pain Point: Losing Discs in Disc Golf

Years of Experience in Engineering

- Rachelle – 9 years
- Pete – 15 years
- Ken – 6 years
- Yiyang – 13 years
- Emily – 5 years

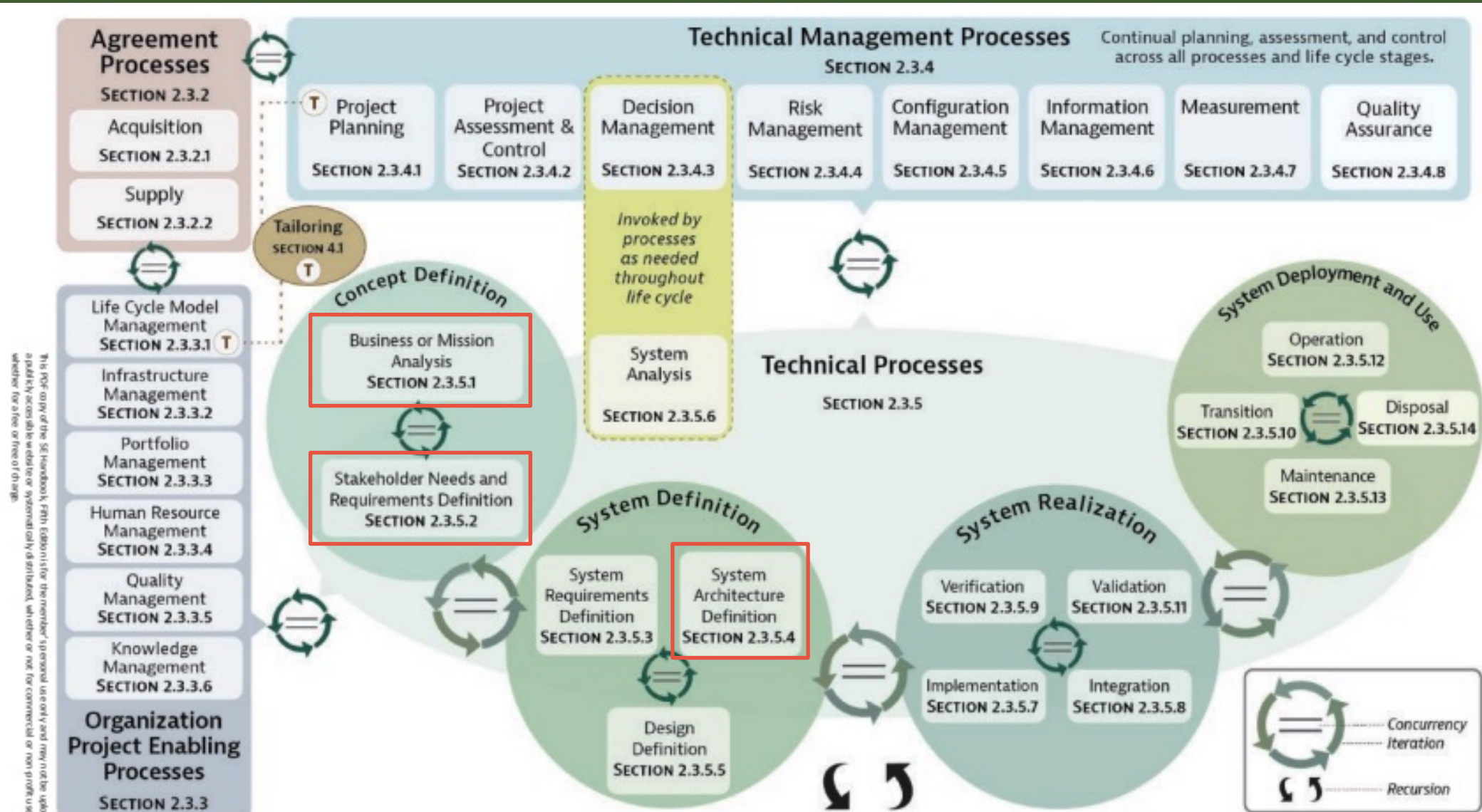


# Use Case Foundation: Disc Golf

Disc golf is played much like golf except, instead of a ball and clubs, players use a flying disc.

-Professional Disc Golf Association

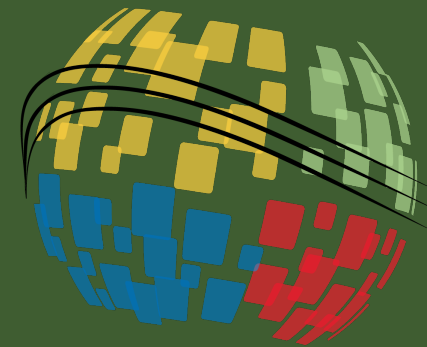




**FIGURE 2.10** System life cycle processes per ISO/IEC/IEEE 15288. INCOSE SEH original figure created by Roedler and Walden. Usage per the INCOSE Notices page. All other rights reserved.

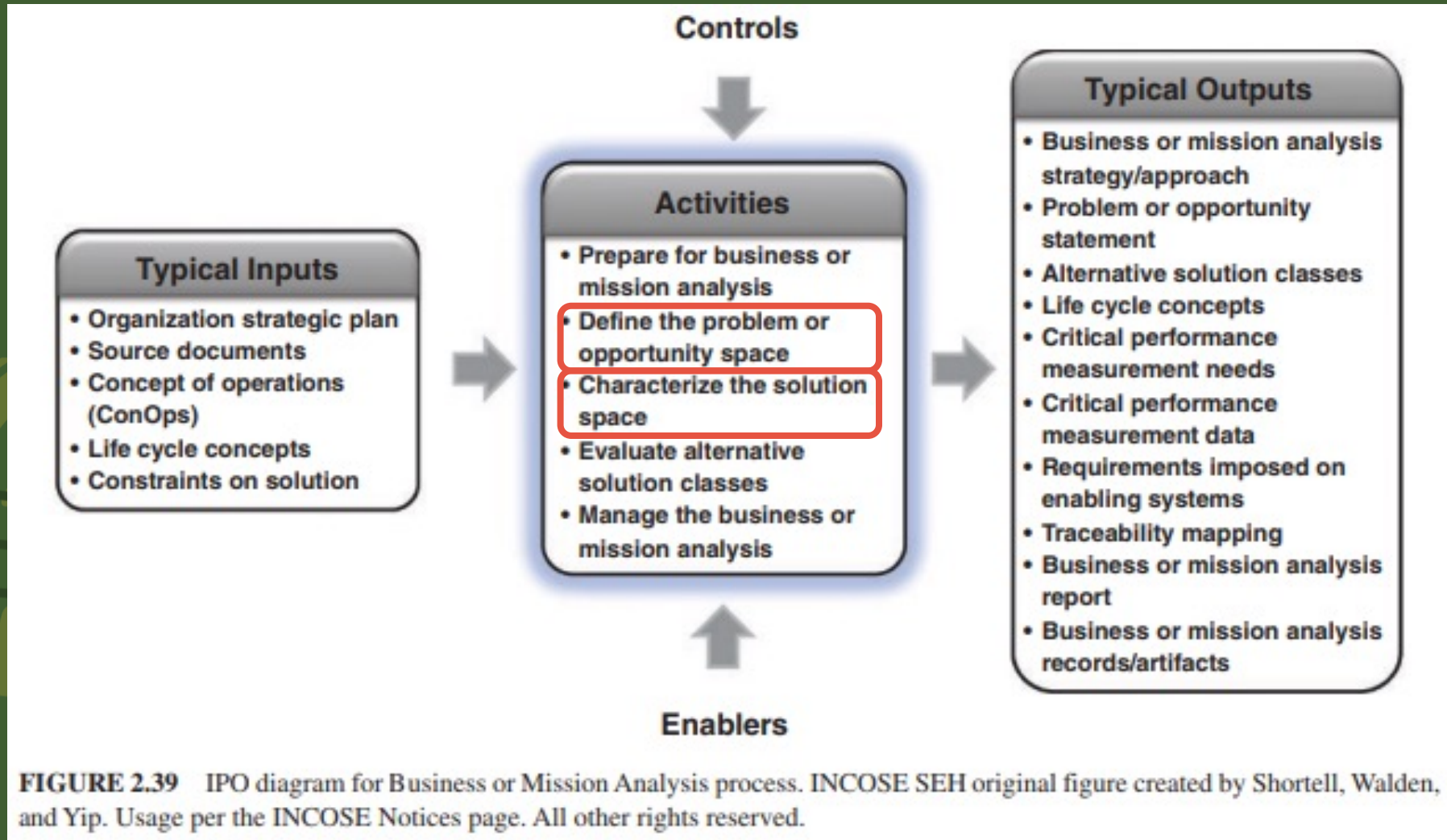
From SE5





# Case Study

# Business or Mission Analysis



# Define the Problem or Opportunity Space

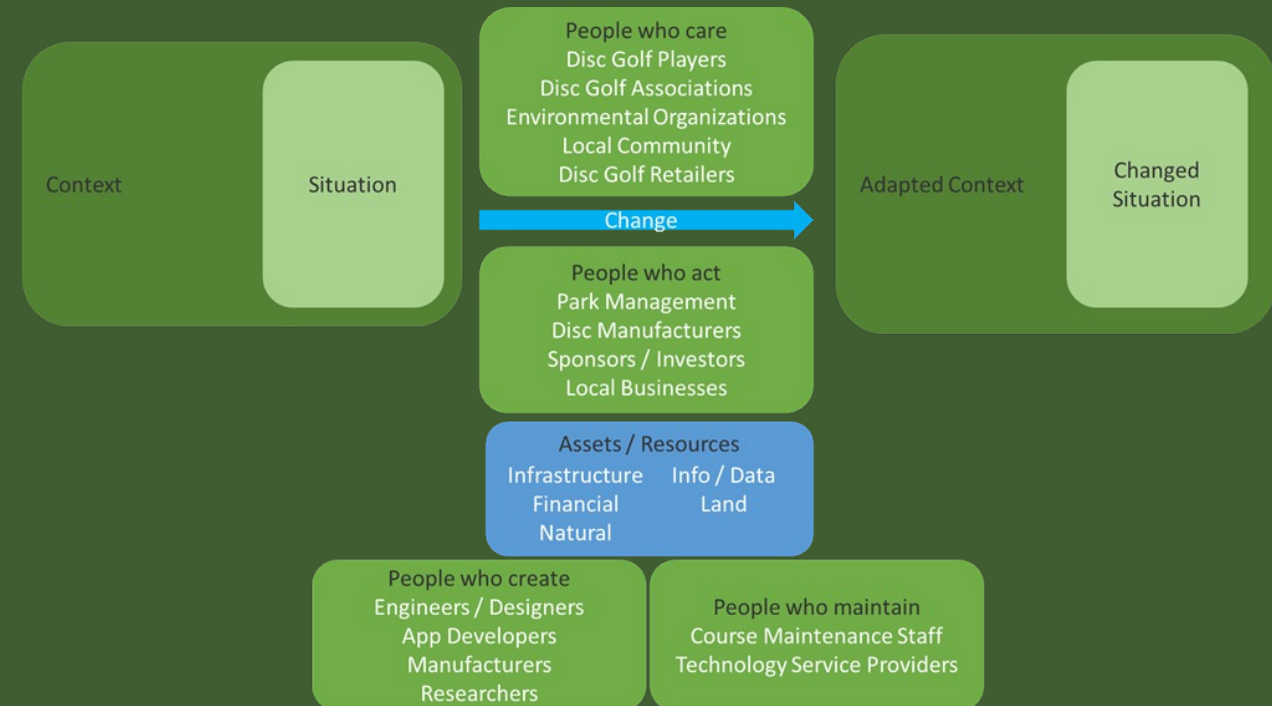
- Asked to identify pains with losing discs
- Asked the same prompts with slight variations in language
- Asked for the problem statement to remain solution-neutral

## ChatGPT Output:

“To enhance the disc golf experience by innovating and implementing effective solutions that minimize the loss of discs, ensuring a more enjoyable, uninterrupted, and sustainable play for enthusiasts of all levels.”

# Characterize the Solution Space

- Asked for a list of stakeholders
- Asked for more information on groups listed



Nine Element Model  
(Sillitto, 2014)



# Characterize the Solution Space






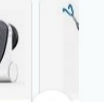

- External searches
  - Benchmarking of similar products on the market
    - Kept language broad to not limit what we would find
  - Patent searches
    - AI understands the CPC codes
    - Keywords can also be used

There are a few products available that can help you locate lost disc golf discs:

1. **MeepMeep Pilot Stick-On Disc Locator**<sup>1</sup>: This is a smart disc golf accessory that sticks to the back of your discs. It only rings when you need it to. You can use the MeepMeep app to set off an alert and save countless hours of searching for your discs<sup>1</sup>.
2. **Innova LOC8™ GPS System**<sup>2</sup>: This system features GPS, Bluetooth 4.0, and NFC all packaged together in a micro-chip, molded directly into the disc rim. Not only does this revolutionary new system allow for disc tracking, it also collects and stores valuable data within the LOC8™ app<sup>2</sup>.

These products can be a great help in locating lost discs and getting back in the game quickly. Please note that availability and prices may vary, so it's always a good idea to check the latest information on the retailer's website.

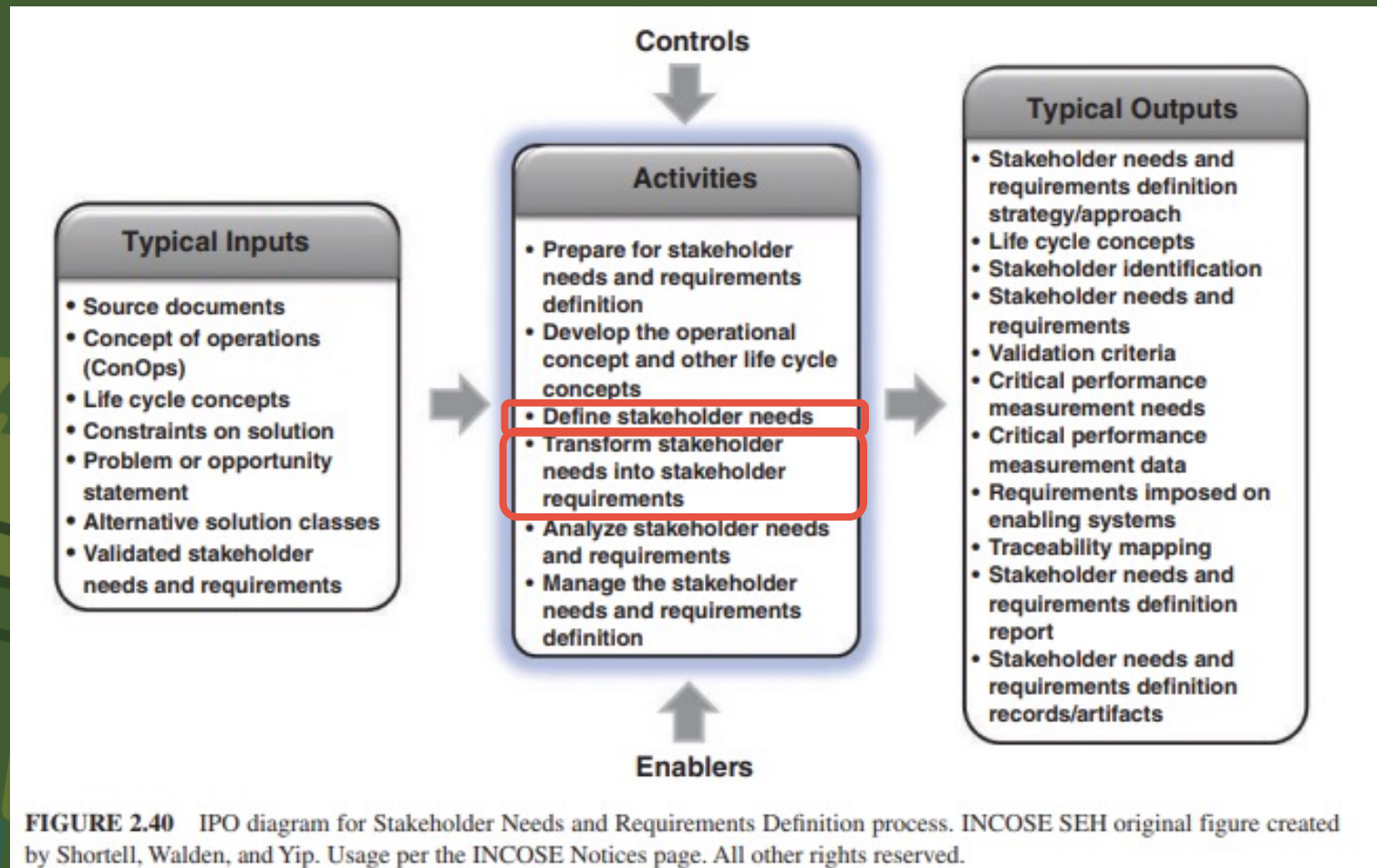
Ads

 Bushnell Edge Disc... \$130.00 eBay	 Disc Golf Audible... \$15.64 Etsy ★★★★★ 20	 INNOVA Star Mamba... \$16.99 Amazon.com	 Yaheetech 12-Chain Di... \$60.04 +\$2.89 Wayfair Free shipping	 Rogue Iron Sports Disc... \$44.99 Amazon.com ★★★★★ 458	 Revasri Golf & Disc Golf... \$150.73 eBay Free shipping	 Discs \$34.9 Ama: ★★★★
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Learn more: [1. meepmeep.co](#) [2. innovadiscs.com](#) [3. team.discraft.com](#) [+2 more](#)

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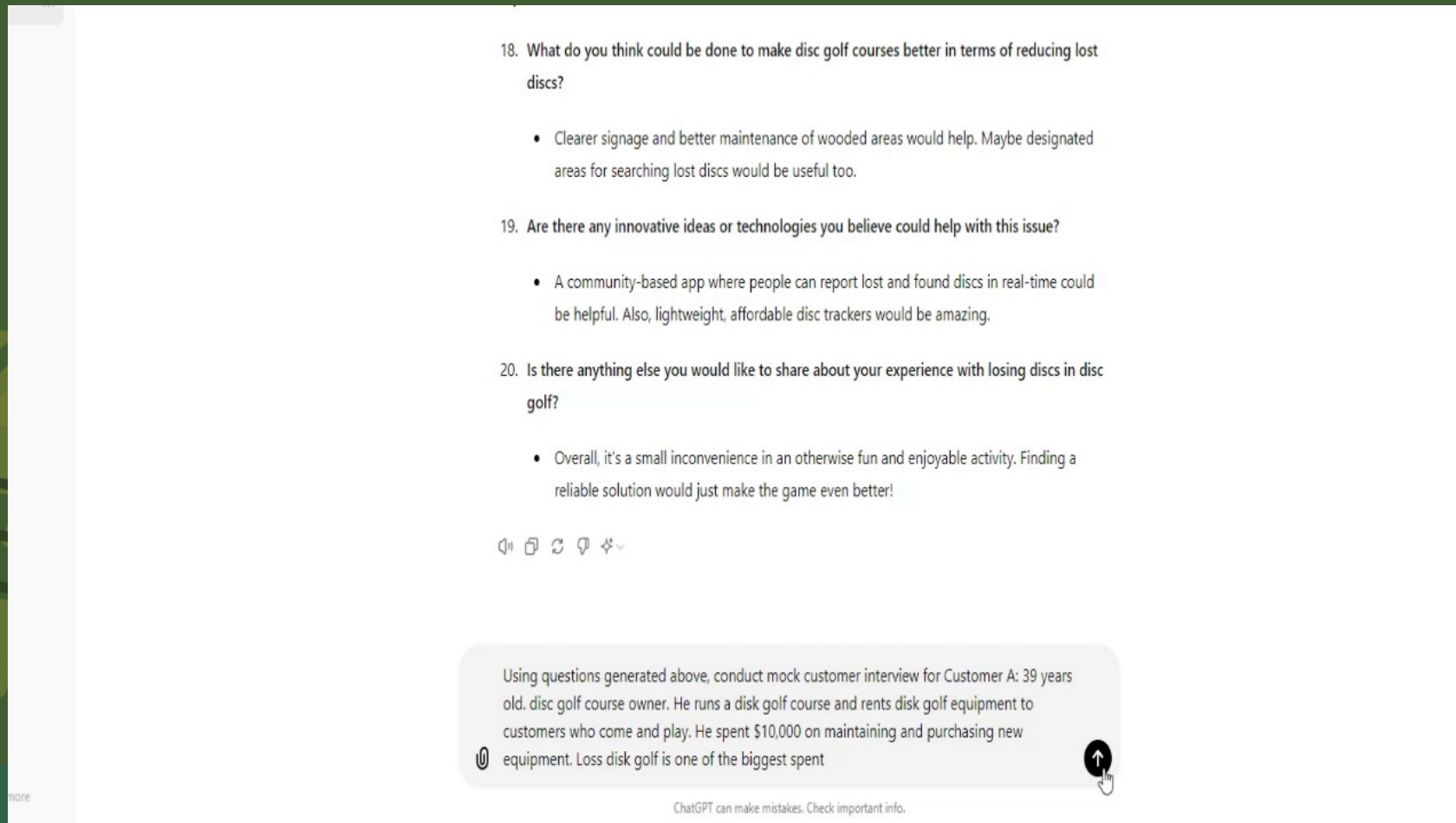
# Stakeholder Needs and Requirement Definition



# Define Stakeholder Needs

- Review Data
  - More Benchmarking
  - Interviews
    - AI was used to create interview questions
    - Constraints can be added for what is acceptable or unacceptable.
    - AI can also take those interview questions and provide answers based on a Customer persona.

# Mock Interview



18. What do you think could be done to make disc golf courses better in terms of reducing lost discs?

- Clearer signage and better maintenance of wooded areas would help. Maybe designated areas for searching lost discs would be useful too.

19. Are there any innovative ideas or technologies you believe could help with this issue?

- A community-based app where people can report lost and found discs in real-time could be helpful. Also, lightweight, affordable disc trackers would be amazing.

20. Is there anything else you would like to share about your experience with losing discs in disc golf?

- Overall, it's a small inconvenience in an otherwise fun and enjoyable activity. Finding a reliable solution would just make the game even better!

🔊 📄 ↺ 🔍 ⚙️

Using questions generated above, conduct mock customer interview for Customer A: 39 years old, disc golf course owner. He runs a disk golf course and rents disk golf equipment to customers who come and play. He spent \$10,000 on maintaining and purchasing new equipment. Loss disk golf is one of the biggest spent

🗨️ ↗️

ChatGPT can make mistakes. Check important info.

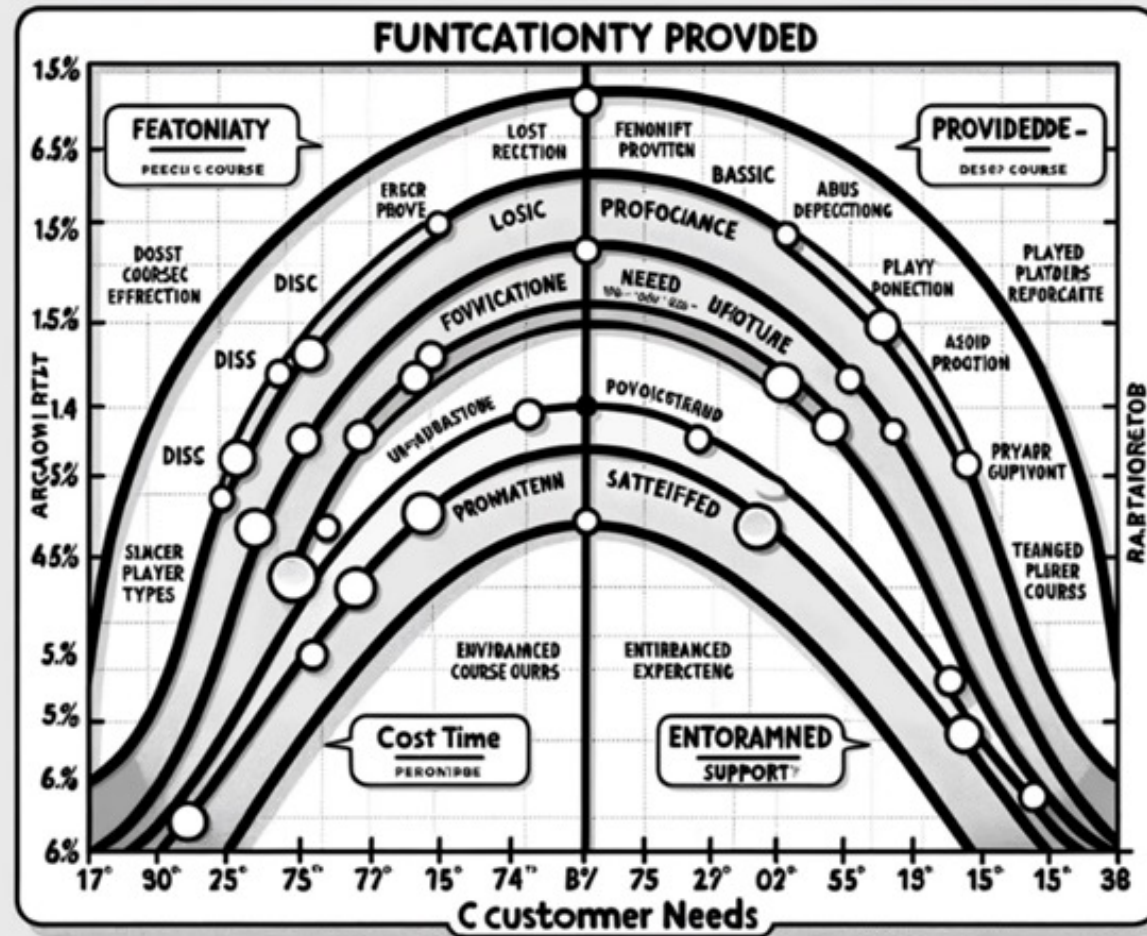


# Transform Stakeholder Needs into Stakeholder Requirements

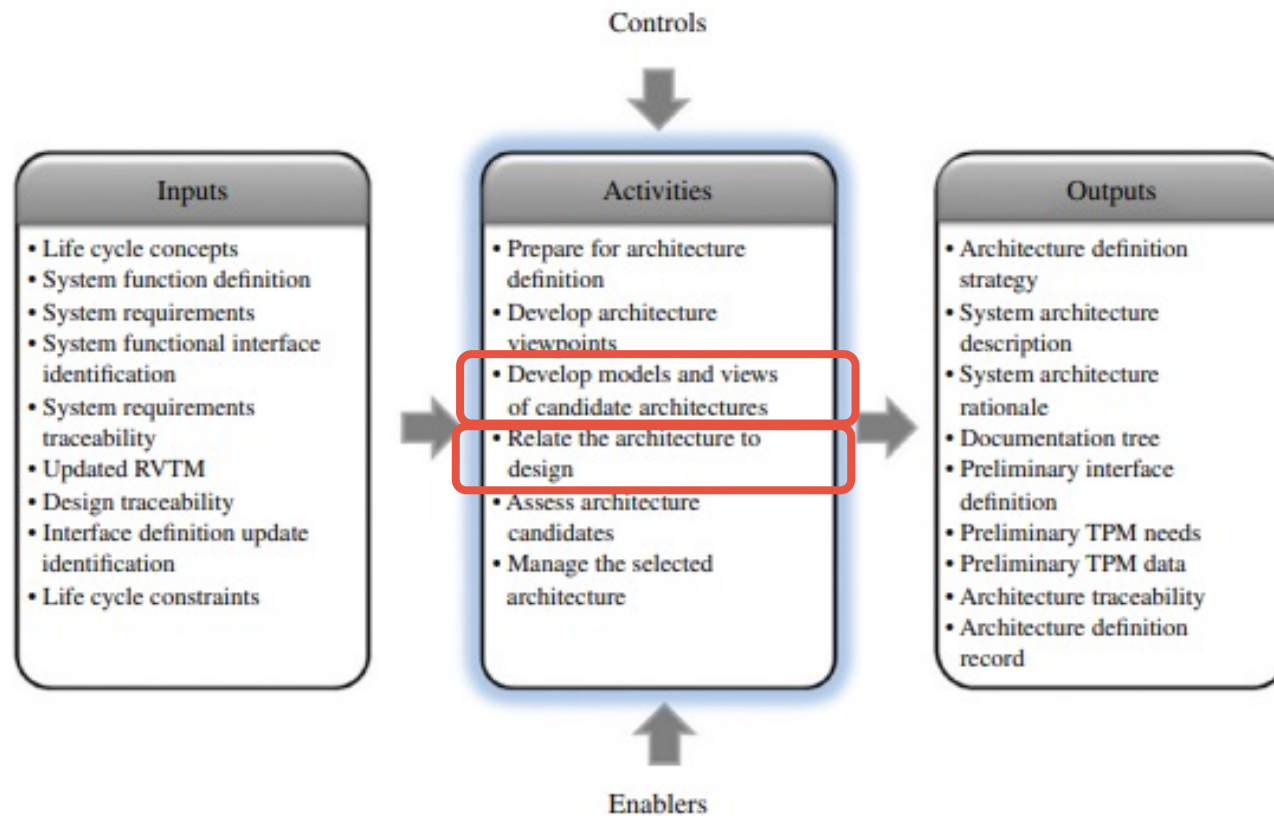
- From the interviews you conduct, or you ask AI to do, you can ask AI to summarize the needs based on these responses.
- Guidance on requirements generation can be provided
- This is one area where a large chat history can be of benefit.

Customer Needs	Kano Category	Description and Priority
Cost-Effective Solution	Performance	The system must be cost-effective, aligning with budget constraints. High satisfaction when met, dissatisfaction when not.
Lost Disc Retrieval Efficiency	Performance	The system should efficiently locate lost discs, especially in wooded areas. High satisfaction when met, dissatisfaction when not.
Environmental Impact Reduction	Performance	The system should minimize the environmental impact of lost discs, reducing clutter on courses. High satisfaction when met, dissatisfaction when not.
Compatibility with Course Types	Basic	The system must be adaptable to different course types (wooded, open, urban). Expected and neutral satisfaction when met, dissatisfaction when not.
Disc Protection	Basic	The system must protect discs from being lost or damaged during gameplay. Expected and neutral satisfaction when met, dissatisfaction when not.
User-Friendly Operation	Basic	The system should be user-friendly and easy to understand and use. Expected and neutral satisfaction when met, dissatisfaction when not.
Real-Time Alerts and Feedback	Excitement	The system should provide real-time alerts or feedback to players about disc status. Delights when met, neutral when not.
Cost Reduction for Course Owners	Performance	For course owners, the system should reduce costs associated with replacing lost discs and equipment. High satisfaction when met, dissatisfaction when not.
Enhanced Player Experience	Performance	The system should enhance the overall player experience by minimizing frustration related to lost discs. High satisfaction when met, dissatisfaction when not.
Tournament Support	Basic	The system should support the smooth operation of disc golf tournaments, ensuring fair play and minimal disruptions due to lost discs. Expected and neutral satisfaction when met, dissatisfaction when not.
Budget Flexibility for Users	Delighter	The system should offer flexible pricing options for users with varying budgets. Delights when met, no dissatisfaction when not.

# It can still give funny results....



# System Architecture Definition



**FIGURE 4.6** IPO diagram for the architecture definition process. INCOSE SEH original figure created by Shortell and Walden. Usage per the INCOSE Notices page. All other rights reserved.

# Develop models and views of candidate architectures

- Determining system boundary is not really easy for AI to help with but it can with decomposing the system.
  - Different decomposition techniques can be prompted to the AI instead of taking the default
  - Table shows example of decomposition by function

Function	ChatGPT Elaboration	Bing Elaboration
Disc Tracking and Retrieval	Implementing systems or technologies that assist players in tracking and retrieving their discs. This could involve the use of RFID tags, or mobile apps that help locate the discs	Develop an efficient system to locate and retrieve lost discs on the course. Implement technologies like GPS trackers or color-coded discs for easy identification. Encourage players to report lost discs and create a community-driven database.
Player Education and Awareness	Developing educational programs or materials to inform players about strategies to minimize disc loss. This could include best practices for throwing techniques, awareness about common disc loss in courses, and how to effectively search for lost discs.	Organize workshops and tutorials for players of all levels. Teach proper throwing techniques, course etiquette, and responsible play. Raise awareness about environmental impact and conservation.
Course Design and Maintenance	Designing disc golf courses with features that reduce the likelihood of disc loss, such as strategic placement of hazards and clear marking of high-risk areas. Regular maintenance of courses to keep them clear of overgrown vegetation can also help in reducing disc loss.	Collaborate with course designers to create layouts that minimize the risk of disc loss. Regularly maintain fairways, remove overgrown vegetation, and mark hazards clearly. Promote sustainable practices to preserve the natural environment.
Innovation in Disc Design	Collaborating with manufacturers to design discs that are easier to find, such as using brighter, more visible colors or materials that respond to electronic tracking.	Research and develop materials that enhance disc durability and visibility. Explore biodegradable options to reduce environmental impact. Partner with manufacturers to create discs optimized for different skill levels.
Community Engagement and Feedback Systems	Establishing platforms for players and other stakeholders to provide feedback on disc loss issues and potential solutions. Engaging the community can also involve organizing events or challenges focused on minimizing disc loss and promoting responsible play.	Foster a sense of community among disc golf enthusiasts. Organize tournaments, leagues, and social events. Promote inclusivity, sportsmanship, and a love for the game.



# Relate the Architecture to Design

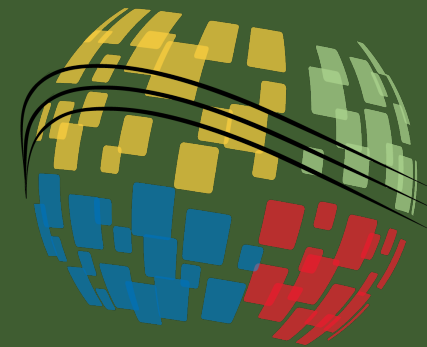
- AI can help define concept classification trees
  - AI tends to be more specific than general, users need to prompt for such answers

	Disc Tracking and Retrieval	Player Education and Awareness	Course Design and Maintenance	Innovation in Disc Design	Community Engagement and Feedback Systems
ChatGPT	GPS-enabled Discs	Instructional Videos	Hazard Placement	Enhanced Visibility	Online Forums
	RFID Tags	Workshops	Clear Signage	Aerodynamic Improvements	Surveys
	Mobile Applications	Social Media Campaigns	Disc-Friendly Landscaping	Durability Enhancements	Community Meetings
	High-Visibility Discs	Online Resources	Regular Trimming of Vegetation	Partnership with Manufacturer	Feedback Boxes
	Reflective Materials	Printed Guides	Clearing Water Hazards	Prototype Testing	Cleanup Drives
	Telescopic Retrievers	Webinars	Pathway Upkeep	Joint Research Initiatives	Awareness Rallies
	Magnetic Retrievers	On-site Signage	Suggestion Boxes	Player Testing	Tournaments with a Focus on Disc Conservation
Bing	GPS-Enabled Discs	Skills Clinics	Low-Hazard Fairways	Biodegradable Discs	Monthly Tournaments
	Color-Coded Discs	Online Tutorials	Visible Markers	High-Visibility Designs	Disc Golf Leagues
	Community Lost & Found	Youth Outreach	Eco-Friendly Tee Pads	Customizable Weights	Environmental Cleanup Days

# Short Delve into Design Definition

- Ask AI for feasible concepts to address subsystems
  - Users can ask for more information on each idea if first explanation is too vague
  - This is a much more interactive process to tease out information needed.
  - AI came up some ideas we had not originally considered and even our final idea, even if it did not rank high when evaluated.

1. Integrated Mobile App Solution	Develop a mobile app that combines GPS tracking for discs, instructional videos on how to avoid disc loss, and a feature for players to report and view commonly lost disc areas on specific courses.
2. Educational Workshops with Enhanced Discs	Organize workshops and training programs that educate players on minimizing disc loss, using high-visibility and aerodynamically improved discs for practical demonstrations.
3. Smart Disc Development Partnership	Collaborate with disc manufacturers to develop smart discs with RFID tags or GPS, and conduct joint research initiatives to test their effectiveness in various course environments.
4. Community-Driven Course Improvement	Utilize community feedback collected through surveys and forums to redesign courses with clear signage, disc-friendly landscaping, and regular maintenance practices that reduce disc loss risk.
5. Disc Golf Awareness and Cleanup Campaigns	Host awareness rallies and cleanup drives that also serve as educational events, teaching players about responsible disc usage and the environmental impact of lost discs.
6. Social Media-Integrated Tracking Technology	Integrate disc tracking technology (like RFID tags or GPS-enabled discs) with a social media campaign, encouraging players to share their experiences and tips on disc retrieval and loss prevention.
7. Prototype Testing Events with Local Clubs	Collaborate with local disc golf clubs to test new disc designs and course layouts, gathering player feedback to refine the designs for better visibility and reduced loss.
8. Visibility and Durability Enhanced Discs	Partner with manufacturers to design discs that are not only more visible but also more durable, reducing the frequency of disc replacement due to wear and tear.
9. Interactive Course Maps with Lost Disc Zones	Develop interactive digital maps of disc golf courses, highlighting high-risk areas for disc loss based on player feedback and maintenance staff input, helping players plan their game strategies accordingly.
10. Regular Player Feedback and Course Modification	Establish a continuous feedback loop with players using feedback boxes and online platforms, leading to regular updates and modifications in course design and maintenance practices based on player experiences and suggestions.

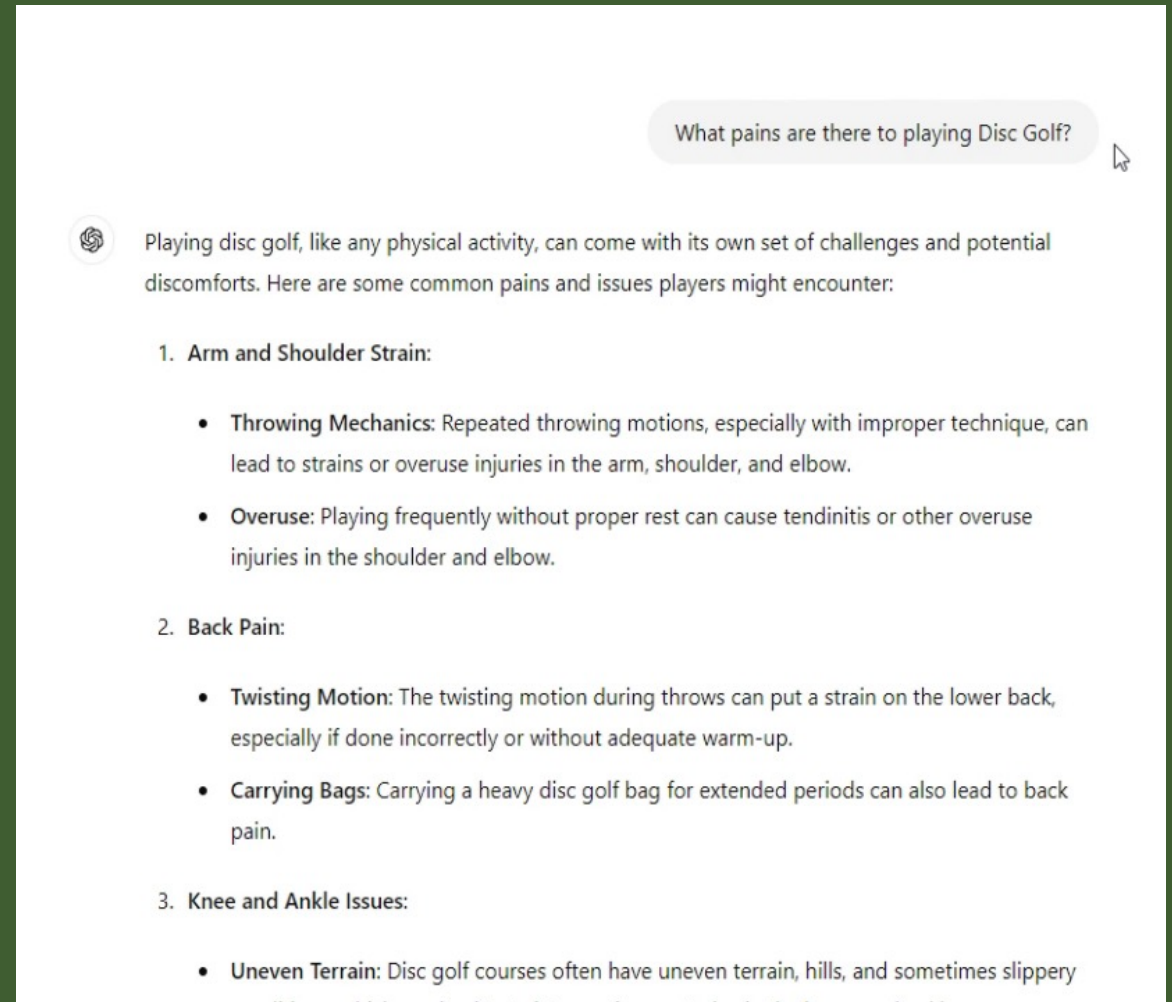


# Results

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# AI vs Human

- Treat AI like a student
  - AI can be “trained” on methods
  - Results are highly dependent on how they are “taught”
  - Wording is important to make sure the AI understands the requests given.
  - Can be asked for its “thought process”
- Chat history can help or hurt when it comes to the next inquiries.
- Users should treat AI like a teammate, not a subject matter expert.



The screenshot shows a chat window with a light gray header bar containing the question "What pains are there to playing Disc Golf?". Below the header, on the left, is a small circular icon with a stylized 'G'. To the right of the icon is the response text. The response starts with a general statement about physical activity challenges, followed by a list of three categories of pain: Arm and Shoulder Strain, Back Pain, and Knee and Ankle Issues. Each category has one or two bullet points describing specific issues like throwing mechanics, overuse, twisting motion, carrying bags, and uneven terrain.

What pains are there to playing Disc Golf?

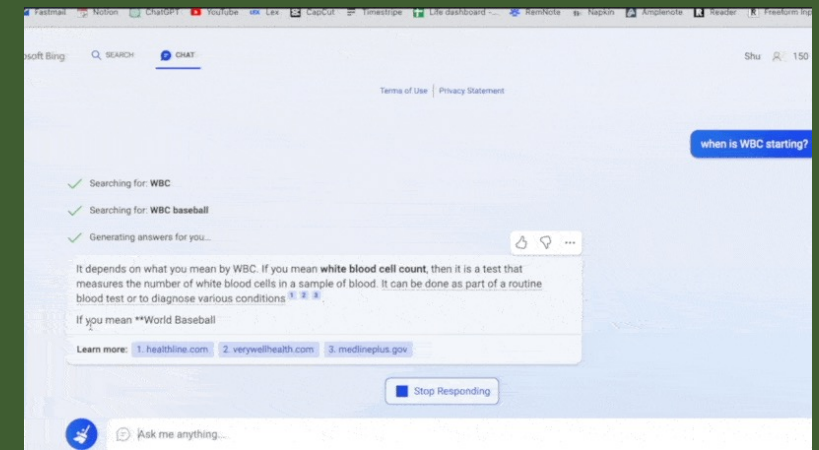
Playing disc golf, like any physical activity, can come with its own set of challenges and potential discomforts. Here are some common pains and issues players might encounter:

1. **Arm and Shoulder Strain:**
  - **Throwing Mechanics:** Repeated throwing motions, especially with improper technique, can lead to strains or overuse injuries in the arm, shoulder, and elbow.
  - **Overuse:** Playing frequently without proper rest can cause tendinitis or other overuse injuries in the shoulder and elbow.
2. **Back Pain:**
  - **Twisting Motion:** The twisting motion during throws can put a strain on the lower back, especially if done incorrectly or without adequate warm-up.
  - **Carrying Bags:** Carrying a heavy disc golf bag for extended periods can also lead to back pain.
3. **Knee and Ankle Issues:**
  - **Uneven Terrain:** Disc golf courses often have uneven terrain, hills, and sometimes slippery



# ChatGPT vs Bing

- References
  - Bing is embedded in a search
  - ChatGPT will not give sources unless asked and this is not 100% of the time.
  - ChatGPT also has a limited memory of up to Sept 2021 for 3.5. 4.0 does say it is limited but does not give a date.
- Answer Length
  - Bing gives much shorter answers
  - ChatGPT will be thorough in its answers compared to Bing.
- Bing limitations
  - Get 300 chats per day with 30 per chat



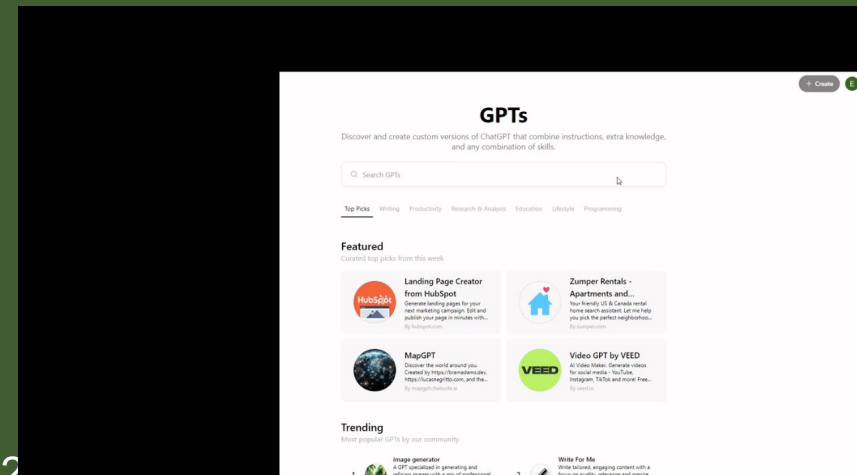
# ChatGPT 3.5 vs ChatGPT 4.0

## ChatGPT 3.5

- Free with login
- Provides similar content to 4.0, just different formatting.
  - Ex: Could provide the same formulas for a Analytic Hierarchy Process but 4.0 could not complete the math while 3.5 could.

## ChatGPT 4.0

- Free limited usages with paid subscription
- Different paid features:
  - DALL-E 3's image generator
  - Voice chats
  - ChatGPT custom bots



# Future Trends

- AI Usage will continue to increase
  - Clerical Use: Emails and Meeting Agenda/Minutes
  - Software/Code generation
- Web UI within Company intranets
- Applications with embedded AI features
  - Documentation (Microsoft)
  - Coding (Github)
- APIs exposed for developer use
- Existing app extensions to ChatGPT UI
- Will not replace the human, at least not in the near term
  - Outputs of AI must always be reviewed



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