



ARCS OF IMPACT

**RELATING SYSTEMS THINKING & DESIGN
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Concept Design of Next-Generation Endurance-Enhancing Textiles for Athletes

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This project aims to elevate the endurance and performance of Indian athletes by systemically comprehending the cutting-edge recovery technologies, reducing injury risks, and optimising training efficiency through advanced technical textiles and intelligent sensor systems, for which we followed a system design process.

Using the gigamap, we ideated an innovative, preventive, data-driven wearable concept that will improve the endurance of athletes by preventing overtraining through continuous monitoring of muscles, regulating body temperature, and providing real-time data and health-related information.

After performing secondary research about the stakeholders and factors that influence the sports ecosystem, we came up with five prominent systemic influencers that affect endurance at various levels: Institutions & Government Bodies, Training, Diet & Nutrition, Healthcare, and Environment. From here, we zoomed in on each of the systemic influencers in depth to get the emergent factors by applying ZIP Analysis.

Then we established connections between various factors and identified areas where the maximum intersection of connections is found, and considered those as our intervention points. Our five major intervention points were: Recovery (Prevention), Technology (personalisation), Training (Rest), Mental Well-being (Sleep), and Nutrition (Hydration). Then we did an impact analysis where recovery was found to be the leverage point. The proposed concept of the Athlete suit will enable athletes to become more independent in managing their

training, endurance and performance, considering training camps and the coaching industry too.

KEYWORDS: endurance, indian athletes, hydration, nutraceuticals, sensory scientists, personalisation, overtraining, revenge effects, training, ergonomics, mental well-being, technology, recovery

RSD TOPIC(S): Health & Well-Being, Mapping & Modelling

Context

Running, one of the most popular and accessible sports, caters not only to professional athletes but also to individuals seeking general fitness. Endurance is one of the most essential factors for running not only longer but also smarter. It is the ability to sustain physical and mental activities over an extended period. It can be understood as the combination of stamina, which is the ability to keep going, and resilience, which is the ability to recover from fatigue or discomfort. Endurance is not just about running longer; it's about running smarter. It allows athletes to perform better over extended periods, recover faster between training sessions, and build mental toughness for competition. For instance, an athlete with high endurance can complete a 10 km race without slowing down in the final kilometres, which is a critical advantage in competitive sports. Focusing on endurance can unlock untapped potential among athletes who often face challenges like limited resources or recognition.

Intentions and Concept

This project discusses what endurance is, why it matters for athletes, and how we can improve it. Endurance is an integrative concept, which means multiple measure points are taken into consideration. When covering each aspect, it is essential to understand how athletes can perform better over extended periods and how all these different parts can relate to each other holistically to improve endurance. We explored different ways to assist the athletes during their sessions and found "Recovery" as the emergent factor. Different concepts were ideated to improve endurance.

After going through multiple iterations, we continued with the concept of the suit. It enabled the best placement of straps and sensors that allowed for accurate tracking without sacrificing comfort, which was really important to us.

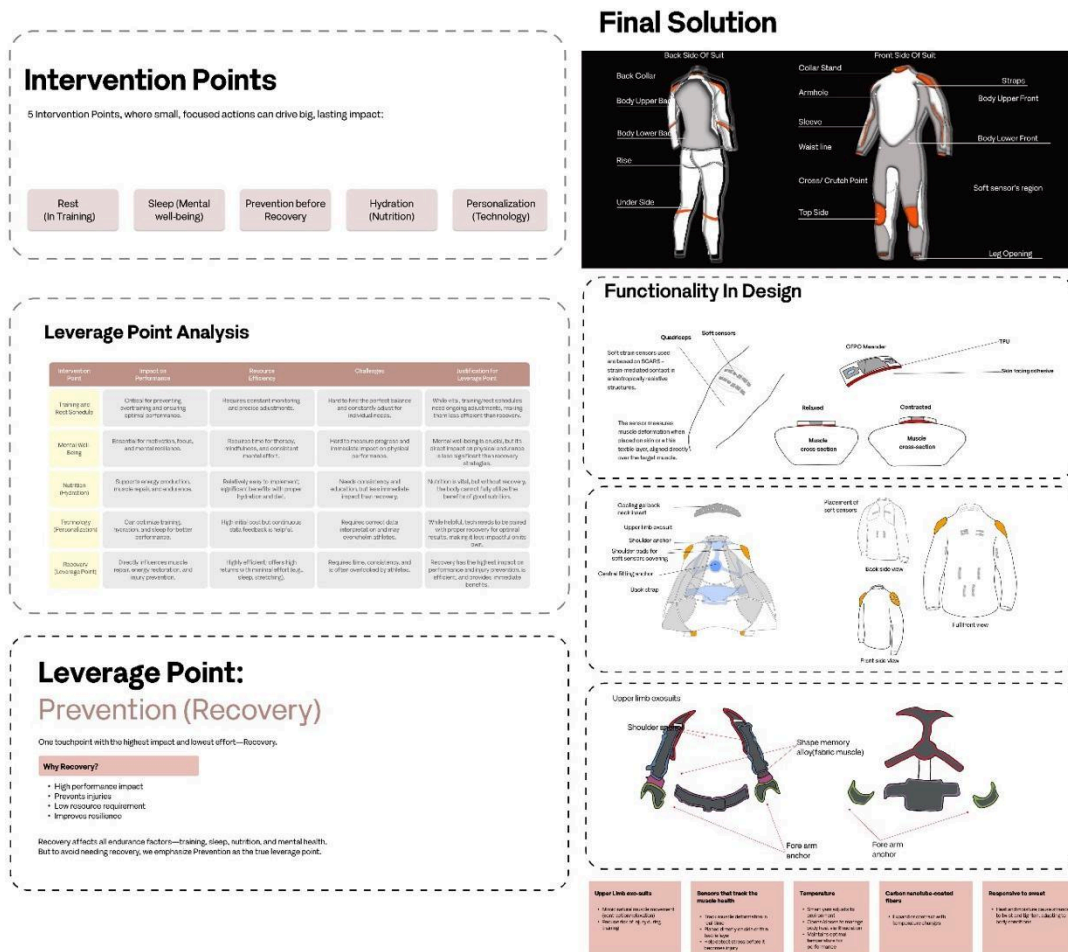


Figure 1: Concept of the suit along with the associated intervention points and leverage point analysis

If it's not comfortable, athletes won't wear it—no matter how advanced the tech is. Comfort and design were just one part of the equation. We also asked ourselves: *how will this actually help an athlete in their daily life?* That's when we focused on a core problem, which was injuries. We found that most injuries happen during training, not during performance. So we thought, what if the suit idea could act as an early warning system?

This final suit design concept tracks muscle activity in real-time (Figure 1). If it detects that a muscle is under strain and approaching a risky threshold—like the point where it might tear then it sends an alert. That way, athletes get a heads-up before any serious damage happens. The idea is to help them push their limits, but safely.

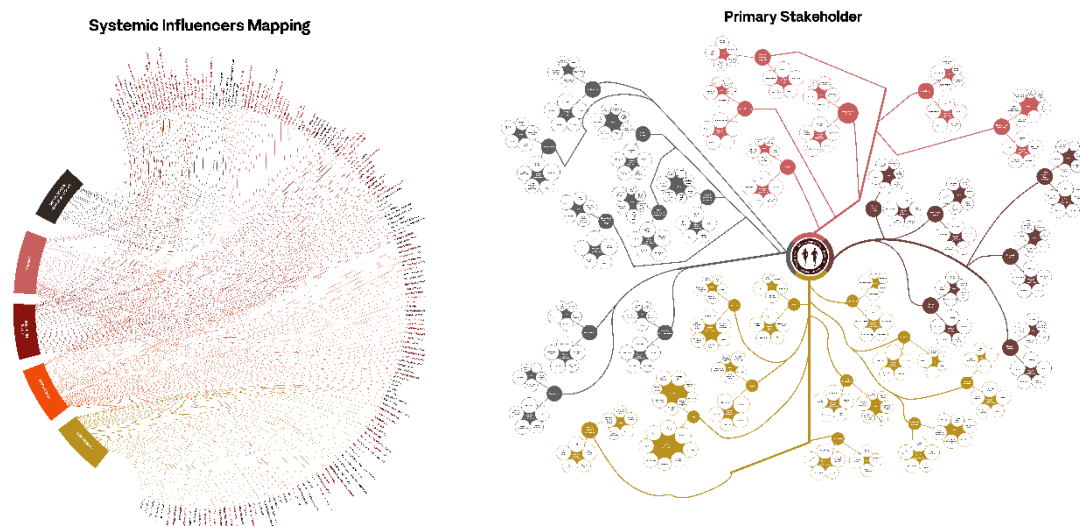


Figure 2: Systemic influences and primary stakeholders

In short, we're not just building a wearable, but we're designing a training companion that can potentially extend an athlete's career by reducing preventable injuries.

Creative Process

Understanding who influences an athlete's endurance journey is important for creating effective strategies that support their development. So, different stakeholders based on their level of impact and interaction with the Athletes were classified to understand what roles they play in an athlete's life.

Then we identified the main factors which affect endurance of athletes, being Training (Faga *et. al.* 2023), Diet and Nutrition, Healthcare, Government Policies, and Environment (Brach *et. al.* 2017). From there, we dug into systemic influencers and analysed emergent factors, which are patterns or issues arising from system interactions, then grouped the main factors to create actionable insights. Then we applied ZIP Analysis starting from the Daily Life of an athlete, extremity insights

of different variables, training equipment, warm-up (Esc *et. al.* 2024), rest and cool-down, ergonomics, healthcare (Scheer *et. al.* 2022), diet and nutrition, nutraceuticals (Uthoff *et. al.* 2018) & hydration, environment (Wang *et. al.* 2024), mental well-being, communities, policies, dress & attire, technology (Burwitz *et. al.* 1994) and skincare to understand their various benefits and barriers in detail.

It helped us in making connections between each of the aspects in the gigamap, where we identified potential intervention points being: a) Training (Rest); b) Mental well-being (sleep); c) Recovery (Prevention); d) Nutrition (Hydration); e) Technology (Personalisation).

We evaluated their impact on performance, where we justified the selection of leverage points based on insights gained (Figure 1). From our analysis, we found that recovery is a critical leverage point due to its high impact on performance and injury prevention, offering immediate benefits with minimal effort.

After the Leverage Point estimation, solutions were brainstormed to address gaps in Athlete recovery systems, focusing on enhancing performance through innovative tools, promoting awareness of sustainable endurance practices.

Then, with the impact analysis to evaluate recovery solutions for their effectiveness, understand their impact on athlete performance, identify challenges, and determine best use cases, it revealed that the Suit concept has the highest impact on recovery due to its real-time fatigue monitoring (Gilbert *et. al.* 2016) and injury prevention capabilities compared to sleeping pod and social media campaigns.

Reflection

With our gigamapping, we were able to see the full complexity of the system by connecting all the different factors. It allowed us to look at the problem from a holistic perspective. We tried to relate whether our analyses make sense with each other, as we found that endurance is a relational systemic concept. From there, we found the following insights, including Revenge effects, which highlight the risks of overtraining. Endurance is an emergent phenomenon, as it arises from the dynamic interactions and

interdependencies between training, diet & nutrition, healthcare (Rundell *et. al.* 2012), environment (Cusick *et. al.* 2023), and lifestyle (Mantzios *et. al.* 2021).

Conclusion

Our project on endurance addressed how athletes train, recover, and stay safe while doing what they love. What really stood out was how this concept could support athletes during their training sessions, which is when most injuries tend to occur, so it bridges the gap by training harder and smarter, without compromising their health.

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