

# Activity 8.2 Apply an emerging technology to enhance a given application system design, demonstrating innovation and critical thinking

Access course FAQ chatbot (<https://lms.griffith.edu.au/courses/24045/pages/welcome-to-the-course-chatbot>)

## Module 8 - Research and apply emerging technologies

---

The image shows a video player interface. On the left, there is a portrait of a woman with long dark hair, wearing an orange blouse and black pants, standing with her hands clasped. To her right, the text "Abby's introduction to:" is displayed above the large title "Activity 8.2". On the far right, the Griffith University logo is visible. At the bottom left of the video player, a progress bar indicates "0:00 / 1:44".

## What is this activity?

In Activity 8.2, you will apply an emerging technology to enhance a given application system design, demonstrating innovation and critical thinking. This activity is designed to help you translate your research findings and insights from Activity 8.1 into practical, innovative solutions that can significantly improve the functionality, performance, and user experience of application systems. By selecting and implementing an emerging technology that aligns with the specific requirements and goals of your

chosen application system design project, you will gain valuable hands-on experience in leveraging cutting-edge technologies to drive innovation and deliver value to users and stakeholders.

**The final output of Module 8 is a detailed report section that addresses the research and application of emerging technologies to your chosen assignment scenario**

(<https://lms.griffith.edu.au/courses/24045/assignments/93487>). This should include an in-depth analysis of the impact of these technologies on application system design, proposed integration strategies, and a clear rationale for the selected technologies, ensuring the application system remains innovative and competitive.

## Why is this activity important?

By engaging in this activity, you will develop the ability to critically evaluate the potential of different emerging technologies and to strategically implement them in ways that maximise their benefits and minimise their risks. Some key benefits of this activity include:

**Developing practical skills in implementing emerging technologies** - Through hands-on experience in selecting, integrating, and optimising an emerging technology for your application system design project, you will gain valuable technical skills and knowledge that can be applied to a wide range of real-world scenarios. This practical experience will complement your theoretical understanding of emerging technologies and enhance your overall competence as an application system designer.

**Fostering a culture of innovation and continuous improvement** - By actively seeking out opportunities to apply emerging technologies to your application system design projects, you will cultivate a mindset of innovation and continuous improvement. This mindset will enable you to stay ahead of the curve, anticipate future trends and disruptions, and proactively adapt your skills and approaches to deliver cutting-edge solutions that meet evolving user needs and expectations.

**Enhancing the impact and value of your application system design projects** - Incorporating emerging technologies into your application system design projects can significantly enhance their impact and value for users and stakeholders. By leveraging the unique capabilities and benefits of emerging technologies, you can create application systems that are more efficient, effective, engaging, and scalable, thereby delivering greater business value and user satisfaction.

**Differentiating yourself as an innovative and forward-thinking application system designer** -

Demonstrating your ability to effectively apply emerging technologies to application system design projects can help you stand out in a competitive job market and position yourself as an innovative and forward-thinking professional. This differentiation can lead to exciting career opportunities, leadership roles, and the chance to work on groundbreaking projects that shape the future of application system design.



## Case study

- ▶ PredictGuard - Predictive Industrial Equipment Maintenance Application System



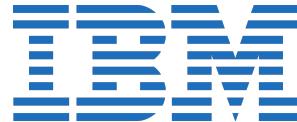
## Supporting content for this activity

You should then work through the content elements below. These will reinforce the principles and elements from the lab exercise and will provide you with the knowledge and tools that you need to successfully complete this activity.

- ▼ Supporting content A - Improving system performance and efficiency

### Real-world examples and case studies of application systems that have achieved significant performance and efficiency gains through the implementation of emerging technologies

Here are several real-world examples and case studies where application systems have achieved significant performance and efficiency gains through the implementation of emerging technologies:



#### AI in Healthcare Diagnostics: Case Study - IBM Watson Oncology

IBM Watson Oncology is an AI system that assists oncologists in making treatment decisions by analysing patient data and medical literature. Memorial Sloan Kettering Cancer Center collaborated with IBM to train Watson on their oncology treatment protocols. The system has improved efficiency by providing treatment options in minutes, a process that would take human oncologists several hours or days. This has led to faster treatment plans and has the potential to increase patient throughput, thereby improving the overall performance of cancer care delivery.



### Edge Computing in Retail: Case Study - Walmart

Walmart has implemented edge computing to enhance its retail operations. By processing data at the edge (closer to the source), Walmart has been able to reduce latency and improve the efficiency of its inventory management systems. For example, edge computing enables real-time monitoring of store conditions, such as refrigeration temperatures, which can prevent spoilage and save energy. This has led to significant cost savings and improved operational efficiency.



### Blockchain in Supply Chain: Case Study - Maersk and IBM

Maersk, the global shipping giant, partnered with IBM to develop a blockchain solution called TradeLens. This platform digitises and streamlines the process of supply chain transactions, making them more secure and efficient. TradeLens has reduced paperwork, improved transparency, and increased the speed of customs document processing, leading to faster shipment times and reduced administrative costs.



### 5G in Manufacturing: Case Study - Ericsson and ABB

Ericsson and ABB have collaborated to explore the use of 5G technology in manufacturing. 5G's high speed, low latency, and high reliability enable the implementation of advanced robotics and automation in factories. This has led to increased production efficiency, reduced downtime, and the ability to perform complex tasks that were previously not possible due to connectivity limitations.



### IoT in Smart Cities: Case Study - City of Barcelona

The city of Barcelona has implemented IoT solutions to improve urban services and efficiency. For example, smart lighting systems adjust streetlight brightness according to ambient light and traffic, saving energy and reducing costs. Additionally, IoT sensors monitor waste levels in bins, optimising waste collection routes and reducing fuel consumption and emissions.



### Quantum Computing in Drug Discovery: Case Study - Biogen and 1QBit

Biogen, a biotechnology company, partnered with quantum computing firm 1QBit to apply quantum algorithms to drug discovery processes. Quantum computing's potential to perform complex calculations at unprecedented speeds could significantly accelerate the discovery of new drugs, making the process more efficient and potentially leading to new treatments for diseases.



### Autonomous Vehicles in Transportation: Case Study - Waymo

Waymo, an autonomous vehicle company, has been testing and deploying self-driving cars. Autonomous vehicles have the potential to improve traffic efficiency, reduce accidents caused by human error, and decrease fuel consumption. Waymo's early results suggest that self-driving technology can lead to smoother traffic flow and reduced travel times.

---

These examples demonstrate how emerging technologies such as AI, edge computing, blockchain, 5G, IoT, quantum computing, and autonomous vehicles are being applied to enhance system performance and efficiency across various industries. Each case study illustrates the potential for innovation to drive significant improvements in operational effectiveness and cost savings.

---

## Best practices and design patterns for optimising application system performance and efficiency with emerging technologies



When optimising application system performance and efficiency with emerging technologies, it is crucial to adopt best practices and design patterns that **leverage the unique capabilities** of these technologies while ensuring scalability, reliability, and maintainability. One best practice is to employ a **microservices architecture**, which allows for the decomposition of an application into small, independent services that can be developed, deployed, and scaled individually. This approach facilitates the integration of emerging technologies into specific services without disrupting the entire application, enabling incremental innovation and performance improvements.

Another key practice is to implement **containerisation** and **orchestration tools** such as Docker and Kubernetes. Containers provide a lightweight, portable, and consistent environment for running applications, which is particularly beneficial when adopting new technologies that may have specific runtime requirements. Kubernetes automates the deployment, scaling, and management of containerised applications, ensuring that resources are efficiently allocated and that the application can adapt to varying workloads, thus enhancing performance and efficiency.

Furthermore, adopting a **DevOps** culture and utilising **continuous integration/continuous deployment** (CI/CD) pipelines can streamline the integration and testing of emerging technologies within the application system. **Automated testing and monitoring** are essential to ensure that performance and efficiency gains are realised without compromising the stability and security of the system. By integrating performance metrics and feedback loops into the development process, teams can make data-driven decisions to optimise the application for the best possible user experience and operational efficiency.

---

## Common challenges and pitfalls in implementing emerging technologies for performance and efficiency optimisation, and strategies for overcoming them



Implementing emerging technologies for performance and efficiency optimisation often comes with a set of challenges and potential pitfalls that organisations must navigate. One common challenge is the **integration of new technologies with legacy systems**. Legacy systems may have outdated architectures, incompatible data formats, or insufficient scalability, which can hinder the seamless integration of innovative technologies. To overcome this, organisations should adopt an **incremental approach**, starting with small-scale pilots and gradually expanding the scope as they learn what works best. This strategy allows for the identification and resolution of integration issues without disrupting existing operations.

Another challenge is the **management of data** in increasingly complex and distributed environments. Emerging technologies often generate vast amounts of data that need to be processed and analysed efficiently. However, without proper data management strategies, this can lead to bottlenecks, data silos, and increased latency. To address this, organisations should implement **robust data governance policies** and leverage technologies such as edge computing and distributed data processing frameworks. These approaches enable data to be processed closer to the source, reducing latency and improving overall system performance.

Moreover, the rapid evolution of emerging technologies can lead to **skills gaps** within an organisation. Employees may lack the necessary expertise to effectively implement and manage new technologies, which can slow down adoption and limit the potential benefits. To mitigate this,

organisations should invest in training and professional development to upskill their workforce. Collaborating with technology vendors and external experts can also provide the necessary knowledge transfer and support. Additionally, fostering a **culture of innovation** and **continuous learning** can help employees stay abreast of the latest technological advancements, ensuring that the organisation remains competitive and agile in the face of technological change.

## Metrics and tools for measuring and monitoring the impact of emerging technologies on application system performance and efficiency

To effectively measure and monitor the impact of emerging technologies on application system performance and efficiency, organisations can use a variety of metrics and tools. Here are several key metrics and tools that can be employed:

### 1. Performance Metrics:

- Response Time: Measures the time it takes for a system to respond to a given request.
- Throughput: Quantifies the number of transactions or tasks a system can handle in a given time frame.
- Latency: Assesses the delay between initiating a request and the start of the response.
- Resource Utilisation: Monitors the usage of system resources such as CPU, memory, disk I/O, and network bandwidth.

### 2. Efficiency Metrics:

- Energy Consumption: Tracks the amount of power used by the system, which is particularly relevant for technologies like cloud computing and edge devices.
- Cost per Transaction: Calculates the cost efficiency by measuring the cost of processing a single transaction or task.
- Scalability: Assesses the system's ability to handle increased load without a proportional increase in response time.

### 3. Reliability and Availability Metrics:

- Mean Time Between Failures (MTBF): Measures the average time between system failures.
- Mean Time to Repair (MTTR): Quantifies how quickly a system can be restored after a failure.
- System Uptime: Monitors the percentage of time the system is operational.

### 4. Tools for Monitoring and Analysis:

- Application Performance Monitoring (APM) Tools: Such as Dynatrace, New Relic, or AppDynamics, which provide real-time data on application performance, including response times, throughput, and error rates.
- Infrastructure Monitoring Tools: Like Nagios, Zabbix, or Datadog, which monitor the health and performance of the underlying infrastructure.

- Log Analysis Tools: Such as Splunk, ELK Stack (Elasticsearch, Logstash, Kibana), or Graylog, which help in analysing log data to identify performance issues and bottlenecks.
- Synthetic Monitoring Tools: Like UptimeRobot or Pingdom, which simulate user interactions to proactively monitor application availability and performance from different geographic locations.
- Real User Monitoring (RUM) Tools: Which track actual user interaction with the application to provide insights into user experience metrics.

## 5. Business Metrics:

- Customer Satisfaction: Surveys and feedback tools can measure how changes in performance and efficiency impact user satisfaction.
- Conversion Rates: Track changes in the rate at which visitors complete desired actions on a website or application.

By combining these metrics with the appropriate monitoring tools, organisations can gain comprehensive insights into the impact of emerging technologies on their application systems. This data-driven approach enables informed decision-making and facilitates the continuous improvement of performance and efficiency.

### ▼ Supporting content B - Enhancing user experience and engagement

## Real-world examples and case studies of application systems that have successfully enhanced user experience and engagement through the integration of emerging technologies

Integrating emerging technologies into application systems has become a key strategy for enhancing user experience and engagement. Here are several real-world examples and case studies across different industries:



### Healthcare - Telemedicine with AI:

Company: Babylon Health

Technology: Artificial Intelligence (AI)

Innovation: Babylon Health has integrated AI into its telemedicine platform to provide 24/7 health advice and initial consultations. The AI can diagnose and treat common illnesses, improving user experience by offering immediate and personalised healthcare advice.

# WARBY PARKER

eyewear

## Retail - Virtual Try-On with AR:

Company: Warby Parker (for eyewear) and Sephora (for cosmetics)

Technology: Augmented Reality (AR)

Innovation: Both companies have implemented AR try-on features in their apps, allowing customers to virtually try on glasses or makeup before making a purchase. This enhances engagement by providing an interactive and convenient shopping experience.



# Beat Games

## Gaming - Immersive Experience with VR:

Company: Beat Games (developer of Beat Saber)

Technology: Virtual Reality (VR)

Innovation: Beat Saber is a VR rhythm game where players slash blocks representing musical beats with light sabers. The immersive VR experience has captivated users, leading to high engagement and a strong community of players.

# zSpace

## Education - Interactive Learning with VR/AR:

Company: zSpace

Technology: Augmented and Virtual Reality (AR/VR)

Innovation: zSpace offers an AR/VR platform for K-12 and higher education that allows students to interact with 3D objects in a virtual space. This enhances learning by providing hands-on, immersive experiences that can increase retention and engagement.



### Fitness - AI-Powered Personal Training:

Company: Tempo

Technology: Artificial Intelligence (AI)

Innovation: Tempo is an at-home fitness system that uses 3D sensors and AI to analyse and provide real-time feedback on users' exercise form. It offers personalized workout plans, making home fitness more effective and engaging.



### Automotive - Connected Cars with IoT:

Company: Tesla

Technology: Internet of Things (IoT)

Innovation: Tesla's connected cars not only provide real-time navigation and traffic information but also enable over-the-air updates that improve the vehicle's functionality over time. This keeps the user experience fresh and engaging for drivers.



### Entertainment - Streaming Services with Recommendation Engines:

Company: Netflix

Technology: Machine Learning (ML)

Innovation: Netflix uses sophisticated ML algorithms to analyse user behaviour and provide personalised content recommendations. This enhances user experience by making it easier for subscribers to discover content they'll enjoy.



### Real Estate - Virtual Tours with VR/360 Video:

Company: Matterport

Technology: Virtual Reality (VR) and 360-degree video

Innovation: Matterport creates virtual tours of properties using 3D cameras and VR technology. This allows potential buyers and renters to explore properties remotely, enhancing engagement and convenience.

---

These examples demonstrate how emerging technologies like AI, AR, VR, IoT, and ML are being leveraged to create more engaging and user-friendly application systems across various sectors. By integrating these technologies, companies can offer personalised, interactive, and immersive experiences that resonate with modern audiences.

---

## Design principles and guidelines for creating engaging and intuitive user experiences with emerging technologies



Designing engaging and intuitive user experiences with emerging technologies requires a thoughtful approach that balances innovation with usability. One key principle is to focus on **user-centered design**, where the needs, preferences, and limitations of the end-users are the primary considerations. This involves conducting user research to understand the target audience and their behaviours, creating personas, and developing user journeys that guide the design process. By placing the user at the center, designers can ensure that emerging technologies are implemented in a way that enhances the user experience rather than complicating it.

Another critical design principle is to **prioritise simplicity and clarity**. Emerging technologies can offer complex functionalities, but it's essential to present them in a way that is easy for users to understand and navigate. This means using intuitive interfaces, clear language, and visual cues that guide users through the technology's features. Designers should aim to **minimise cognitive load** by breaking down complex tasks into simpler steps and providing helpful feedback and guidance at each stage of the user journey. **Accessibility** should also be a priority, ensuring that the technology is usable by as wide an audience as possible, including those with disabilities.

Lastly, designers should embrace **iterative design and prototyping** to refine the user experience. Emerging technologies are often new to users, and it may take several iterations to find the most effective and engaging design. **Rapid prototyping** allows designers to test concepts quickly and gather user feedback, which is invaluable for making informed design decisions. **Continuous monitoring of user interactions** post-launch is also crucial for identifying areas for improvement

and ensuring that the technology remains relevant and engaging as user expectations evolve. By adopting a flexible and user-focused design process, creators can harness the full potential of emerging technologies to deliver exceptional user experiences.

## User research and testing techniques for evaluating the impact of emerging technologies on user experience and engagement



User research and testing are essential components in evaluating the impact of emerging technologies on user experience and engagement. Before implementing new technologies, it's crucial to conduct **qualitative research** to understand user needs, behaviours, and expectations. This can involve interviews, focus groups, and ethnographic studies to gather insights into how users interact with current technologies and what they might expect from emerging ones. By establishing a baseline understanding of user experiences, designers and developers can tailor the integration of new technologies to meet or exceed those expectations.

Once emerging technologies are integrated into a prototype or a product, **quantitative user testing** becomes vital. Usability testing, A/B testing, and field studies can provide data on how users interact with the new technology, including their success rates in completing tasks, the time taken to perform those tasks, and the overall satisfaction with the experience. Eye-tracking studies and biometric feedback can also offer valuable insights into user engagement and cognitive load. These quantitative methods help in identifying pain points, understanding user preferences, and measuring the effectiveness of the technology in enhancing the user experience.

In addition to traditional research methods, it's important to adopt an **iterative approach** that includes continuous user feedback loops. This can be achieved through the use of online feedback tools, surveys, and real-time analytics that track user interactions with the technology over time. By monitoring user behaviour and gathering ongoing feedback, teams can make **data-driven decisions** to refine the user experience continuously. Moreover, staying abreast of the latest research techniques and tools specific to emerging technologies, such as VR or AI user testing frameworks, ensures that the evaluation methods evolve alongside the technologies themselves. This comprehensive and adaptive approach to user research and testing not only informs the initial design and development but also supports the long-term success and user engagement of products enhanced by emerging technologies.

## Strategies for balancing the benefits of emerging technologies with user privacy, trust, and ethical considerations

Balancing the benefits of emerging technologies with user privacy, trust, and ethical considerations is a critical challenge that requires a multifaceted strategy. Firstly, **transparency** is key. Users must be



informed about how their data is being collected, used, and shared when they interact with emerging technologies. This involves clear and accessible privacy policies, consent mechanisms that are easy to understand and navigate, and ongoing communication about data practices. By fostering transparency, companies can build trust with users, allowing them to make informed decisions about their privacy.

Secondly, **privacy by design** should be integrated into the development process of emerging technologies. This principle, advocated by scholars like Ann Cavoukian, involves proactively considering privacy implications at every stage of product development. It includes implementing **data minimisation techniques**, ensuring secure data storage and transmission, and designing interfaces that give users control over their data. Privacy by design not only respects user privacy but also can reduce the risk of data breaches and associated legal and reputational damages for companies.

Lastly, **ethical frameworks and governance structures** must be established to guide the deployment of emerging technologies. This involves engaging with stakeholders, including users, policymakers, and industry experts, to develop guidelines that address potential ethical concerns. For instance, the use of AI and ML should be guided by principles that prevent discrimination, ensure accountability, and promote fairness. Additionally, companies should invest in ethical training for their employees and establish channels for users to report ethical concerns. By proactively addressing ethical considerations, organisations can foster a culture of responsibility and trust, which is essential for the sustainable adoption of emerging technologies.

#### ▼ Supporting content C - Enabling new features and functionalities

## Real-world examples and case studies of application systems that have introduced innovative features and functionalities through the implementation of emerging technologies

Here are several real-world examples and case studies of application systems that have introduced innovative features and functionalities through the implementation of emerging technologies:



### Tesla's Autopilot and Full Self-Driving (FSD):

- Emerging Technology: Artificial Intelligence (AI), Machine Learning (ML), and Advanced Driver-Assistance Systems (ADAS).
- Innovation: Tesla's vehicles are equipped with Autopilot, which allows for semi-autonomous driving, and they are working towards full autonomy with their FSD feature. These systems use AI and ML to interpret real-world driving scenarios and make decisions in real-time.
- Impact: Tesla's implementation of these technologies has set a benchmark in the automotive industry, pushing competitors to invest in similar technologies and potentially paving the way for fully autonomous vehicles in the future.



### Netflix's Recommendation Engine:

- Emerging Technology: Machine Learning and Data Analytics.
- Innovation: Netflix uses a sophisticated recommendation system that analyses user behaviour to suggest personalised content. This system learns from viewing habits, ratings, and search history to improve the accuracy of recommendations over time.
- Impact: This feature has significantly enhanced user experience and engagement, contributing to Netflix's success in the streaming market.



### Amazon Go Cashierless Stores:

- Emerging Technology: Computer Vision, Sensor Fusion, and Deep Learning.
- Innovation: Amazon Go stores allow customers to shop without having to check out at a cash register. Cameras and sensors track what customers take off shelves and charge their Amazon accounts automatically as they leave.
- Impact: This technology has revolutionised the retail shopping experience, reducing wait times and streamlining the checkout process. It has also prompted other retailers to explore similar cashierless technologies.



### Alibaba's City Brain Project:

- Emerging Technology: AI, Big Data, and IoT (Internet of Things).
- Innovation: Alibaba's City Brain project uses AI and big data to manage urban traffic. It analyses traffic patterns in real-time and can predict and prevent traffic congestion by optimising traffic light signals.
- Impact: The project has been implemented in cities like Hangzhou, China, and has shown significant improvements in traffic flow and accident response times.



### Zipline's Drone Delivery Service:

- Emerging Technology: Autonomous Drones and AI for Navigation.
- Innovation: Zipline operates a drone delivery service that transports blood and medical supplies to remote areas, particularly in countries like Rwanda and Ghana. The drones are autonomous and can navigate to their destinations using GPS and AI algorithms.
- Impact: This service has dramatically reduced delivery times for critical medical supplies, saving lives and improving healthcare access in remote regions.



### Google Assistant and Smart Home Integration:

- Emerging Technology: Natural Language Processing (NLP) and AI.
- Innovation: Google Assistant can control a wide range of smart home devices, allowing users to manage their home environment with voice commands. It uses NLP to understand and respond to user requests.
- Impact: This integration has made smart homes more accessible and user-friendly, leading to increased adoption of smart home technology.



### SpaceX's Starlink Internet Service:

- Emerging Technology: Low Earth Orbit (LEO) Satellites and Advanced Wireless Technologies.
- Innovation: Starlink aims to provide high-speed internet to remote and rural areas by deploying thousands of LEO satellites. The system uses advanced wireless technologies to beam internet from space to ground receivers.

- Impact: Starlink has the potential to connect the unconnected, bringing internet access to areas where traditional infrastructure is impractical or too expensive.
- 

## Ideation and brainstorming techniques for identifying new features and functionalities enabled by emerging technologies

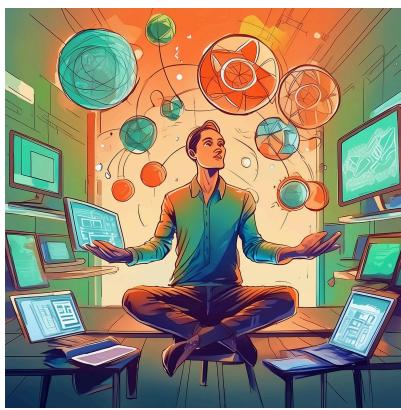


Ideation and brainstorming are crucial steps in identifying new features and functionalities enabled by emerging technologies. One effective technique is "**Design Thinking**," which involves empathising with the user, defining the problem, ideating solutions, prototyping, and testing. By focusing on user needs and challenges, teams can brainstorm a wide range of technology-driven solutions. Another technique is "**SCAMPER**," a checklist of idea-spurring questions based on the acronym for Substitute, Combine, Adapt, Modify, Put to another use, Eliminate, and Reverse. This tool encourages teams to think about how emerging technologies can be applied in new ways or combined with existing technologies to create innovative features.

To further stimulate creativity, teams can use "**Mind Mapping**" to visually organise information and explore possibilities. Starting with a central concept, such as an emerging technology, participants add branches of related ideas, features, and potential applications. This visual approach helps in identifying connections and patterns that might not be apparent in a linear brainstorming session. Additionally, "**Future Workshops**" can be conducted, where participants step into the future and experience a day in the life with the new technology, discussing how it could enhance or change their activities. These techniques, when combined with a deep understanding of emerging technologies, can lead to the discovery of groundbreaking features and functionalities.

---

## Technical considerations and best practices for designing and implementing new features and functionalities with emerging technologies



When designing and implementing new features and functionalities with emerging technologies, several technical considerations and best practices should be taken into account to ensure successful integration and user adoption. Firstly, it is crucial to conduct **thorough research** and **stay updated** on the latest advancements in the relevant emerging technologies. This includes understanding the technology's capabilities, limitations, and potential use cases. Engaging with the developer community and attending industry conferences can provide valuable insights and feedback.

Secondly, a **user-centric** design approach is essential. This involves creating prototypes and conducting user testing to gather feedback on the new features. It is important to ensure that the new functionalities are intuitive, accessible, and align with the users' needs and expectations. Additionally, considering the **scalability** and **maintainability** of the new features is critical. The architecture should be designed to handle increased loads and allow for easy updates and maintenance as the technology evolves. **Security and privacy** should also be prioritised, especially when dealing with sensitive data or integrating with existing systems. Adhering to these best practices can help mitigate risks and ensure that the new features with emerging technologies are well-received and sustainable in the long term.

---

## Strategies for prioritising and roadmapping the development of new features and functionalities based on user needs, business goals, and technical feasibility



Prioritising and roadmapping the development of new features and functionalities is a critical process that requires a balanced consideration of user needs, business goals, and technical feasibility. The first step in this strategy is to conduct a **comprehensive analysis** of user requirements through market research, user interviews, and feedback from existing features. This data helps in understanding the pain points and desires of the user base, which can then be translated into a set of prioritised feature requests. Aligning these requests with the **overall business objectives** ensures that the development efforts

are not only user-centric but also contribute to the growth and success of the organisation.

The second step involves assessing the **technical feasibility** of the proposed features. This includes evaluating the available technology, the skills of the development team, and the integration challenges with existing systems. It is important to create a **realistic timeline** that accounts for the complexity of the features and the potential need for learning or adaptation. A lean approach, such as the **Minimum Viable Product (MVP)** methodology, can be beneficial in this stage, allowing for the rapid development and testing of core functionalities before investing in more complex features.

Finally, the prioritised features should be organised into a **roadmap** that outlines the sequence of development, key milestones, and expected outcomes. This roadmap should be flexible enough to accommodate changes in user needs, business priorities, or technological advancements. Regular reviews and adjustments to the roadmap, based on feedback and performance metrics, will help ensure that the development process remains agile and responsive to the dynamic landscape of emerging technologies. By strategically prioritising and roadmapping the development, organisations can maximise the impact of new features while minimising risks and ensuring a smooth transition for users.

## ▼ Supporting content D - Strengthening security and privacy

# Real-world examples and case studies of application systems that have enhanced their security and privacy posture through the integration of emerging technologies

Integrating emerging technologies into application systems to enhance security and privacy is a growing trend as organisations strive to protect sensitive data and maintain user trust. Here are several real-world examples and case studies where emerging technologies have been successfully applied to strengthen security and privacy posture:



### Blockchain in Supply Chain Management (Provenance)

Provenance is a company that uses blockchain technology to provide transparency and accountability in supply chains. By recording transactions and tracking the provenance of products on a blockchain, Provenance helps companies ensure the authenticity of their products and protect against fraud. This not only enhances security by making the supply chain tamper-evident but also ensures privacy by allowing selective disclosure of information to relevant parties.



### Biometric Authentication in Mobile Banking (Touch ID/Face ID)

Many banking applications have integrated biometric authentication technologies such as Touch ID and Face ID. For example, Capital One's mobile app allows users to securely log in using their fingerprint or facial recognition. This enhances security by providing an additional layer of authentication beyond passwords, while also improving user experience and privacy by reducing the risk of password theft.



### Homomorphic Encryption in Cloud Computing (Microsoft SEAL)

Microsoft's SEAL (Simple Encrypted Arithmetic Library) is an example of homomorphic encryption

being used to enhance privacy in cloud computing. Homomorphic encryption allows computations to be performed on encrypted data without needing to decrypt it first, which means cloud providers can process data without ever knowing its contents. This technology has the potential to revolutionise data security and privacy in cloud-based applications.



### Secure Messaging with End-to-End Encryption (Signal)

The Signal messaging app has become a benchmark for secure communication due to its implementation of end-to-end encryption. This ensures that only the communicating users can read the messages, and not even the service providers can access the content. Signal's technology has been adopted by WhatsApp and other messaging services, demonstrating the impact of emerging cryptographic technologies on enhancing privacy in communication applications.



### AI for Anomaly Detection in Cybersecurity (Darktrace)

Darktrace is a company that uses AI to detect and respond to cyber threats. Its "Enterprise Immune System" learns the normal patterns of an organisation's network and can identify and stop threats that do not match these patterns. This application of AI enhances security by providing real-time threat detection and response, which is particularly effective against advanced persistent threats and insider threats.



### Quantum Key Distribution (QKD) for Secure Communication (ID Quantique)

ID Quantique is a company that provides quantum-safe security solutions, including Quantum Key Distribution (QKD). QKD uses the principles of quantum mechanics to secure the distribution of encryption keys, making it theoretically immune to hacking, even by quantum computers. This

technology is being used to secure critical communications in government and financial sectors, ensuring privacy and security against future threats.



### Zero Trust Architecture in Network Security (Google, BeyondCorp)

Google's BeyondCorp is an example of implementing a Zero Trust architecture, which assumes that threats exist both outside and inside the network perimeter. BeyondCorp enhances security by continuously verifying the trust level of devices, users, and the context of a request before granting access to applications and data. This approach moves away from traditional perimeter-based security and strengthens privacy by minimising the attack surface.

---

These examples illustrate how emerging technologies are being applied to enhance security and privacy in various application systems. As technology continues to evolve, we can expect to see more innovative solutions that leverage these advancements to protect sensitive information and maintain user trust.

---

## Security and privacy risks and vulnerabilities associated with emerging technologies, and strategies for mitigating them



Emerging technologies, while offering significant advancements in security and privacy, also introduce new risks and vulnerabilities. For instance, the **IoT** devices often have **inadequate security measures**, making them susceptible to attacks that can compromise user privacy or serve as entry points for larger network breaches. Similarly, **AI** systems can be **prone to manipulation** through adversarial attacks, where malicious inputs are designed to deceive the AI into making incorrect decisions, potentially leading to security lapses. Furthermore, the centralisation of data in **blockchain systems** can lead to **privacy concerns** if not properly anonymised, and quantum computing, while not yet widespread, poses a future threat to current encryption standards.

To mitigate these risks, it is crucial to adopt a **proactive security posture**. For **IoT** devices, this means implementing robust authentication mechanisms, regular firmware updates, and secure communication protocols. **AI systems** can be hardened through the use of adversarial training, where the AI is exposed to malicious inputs during training to improve its resilience. **Blockchain** privacy can be enhanced through the use of zero-knowledge proofs and other cryptographic techniques that allow for verification without revealing underlying data. Additionally, the development

of post-quantum cryptography is essential to prepare for the future threat of quantum computing to encryption standards.

Another critical strategy for mitigating security and privacy risks is the establishment of **comprehensive governance frameworks and policies**. This includes data protection regulations that set standards for privacy and security, such as the General Data Protection Regulation (GDPR) in the European Union. Organisations should also invest in employee training to raise awareness of security best practices and the importance of privacy. By combining technical solutions with strong governance and education, the risks associated with emerging technologies can be significantly reduced, fostering an environment where innovation can flourish without compromising security and privacy.

## Best practices and design patterns for implementing secure and privacy-preserving application systems with emerging technologies



When implementing secure and privacy-preserving application systems with emerging technologies, it is essential to follow best practices and design patterns that ensure the protection of sensitive data and user privacy. One such best practice is the principle of **data minimisation**, where only the necessary data is collected, processed, and stored for the shortest time possible. This reduces the potential attack surface and limits the impact of data breaches.

Another critical practice is the use of **end-to-end encryption** for data in transit and at rest. This ensures that even if data is intercepted or accessed without authorisation, it remains unreadable to unauthorised parties. Implementing secure defaults, such as enabling encryption by default and requiring strong authentication mechanisms, helps to prevent misconfigurations that could lead to vulnerabilities.

Design patterns that support security and privacy include the use of **microservices architectures**, which can enhance security by isolating different components of an application and reducing the potential for a single point of failure. The use of **API gateways** with built-in security features can also help to control access to these microservices. Additionally, the adoption of **zero trust architecture**, where access to resources is continually validated based on a set of dynamic criteria, can significantly enhance security posture by eliminating the concept of an implicitly trusted network perimeter.

To further enhance privacy, design patterns such as **privacy by design** and **privacy by default** should be incorporated into the development process. This involves considering privacy implications at every stage of the application lifecycle and integrating privacy features that give users control over their data. For example, using pseudonymisation or anonymisation techniques can reduce the risk of re-identification of individuals from datasets.

Finally, it is crucial to **stay informed** about the latest security threats and to continuously monitor and update the application system. This includes regular security audits, penetration testing, and keeping abreast of emerging technologies that can be leveraged to improve security and privacy. By combining these best practices and design patterns, organisations can build application systems that are resilient to attacks and respectful of user privacy.

## Legal and regulatory considerations for ensuring compliance and protecting user data when implementing emerging technologies in application system design



When implementing emerging technologies in application system design, it is crucial to consider legal and regulatory requirements to ensure compliance and protect user data. One of the key considerations is adherence to data protection regulations such as the **General Data Protection Regulation (GDPR)** in the European Union, the **California Consumer Privacy Act (CCPA)** in the United States, and other **regional or national data protection laws**. These regulations often mandate requirements for data handling, including consent for data processing, data subject rights (such as the right to be forgotten), data breach notification procedures, and the appointment of data protection officers for certain organisations.

Another legal aspect to consider is the compliance with **industry-specific regulations**. For example, the Health Insurance Portability and Accountability Act (HIPAA) in the U.S. governs the handling of protected health information, while the Payment Card Industry Data Security Standard (PCI DSS) sets forth requirements for entities that handle credit card information. These regulations impose strict security controls and privacy measures that must be integrated into the design and operation of application systems dealing with such data.

Furthermore, emerging technologies may introduce **novel legal challenges** that require careful consideration. For instance, the use of AI and ML in decision-making processes may raise concerns about algorithmic bias and transparency. Regulations such as the EU's proposed Artificial Intelligence Act aim to address these issues by establishing risk management frameworks for AI systems. Additionally, the use of blockchain technology may require navigating legal issues related to smart contracts and the ownership of digital assets.

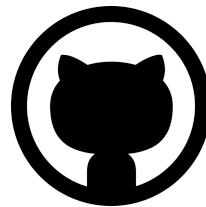
To ensure legal and regulatory compliance, organisations should conduct thorough **risk assessments** and engage with **legal experts** to understand the implications of implementing emerging technologies. This includes developing policies and procedures that align with legal requirements, obtaining necessary certifications and audits, and maintaining transparency with users

about data handling practices. By proactively addressing these legal and regulatory considerations, organisations can mitigate risks and build trust with their users.

#### ▼ Supporting content E - Optimising development and maintenance processes

## Real-world examples and case studies of application system development teams that have optimised their processes and workflows through the adoption of emerging technologies

Adopting emerging technologies can significantly optimise development and maintenance processes for application system development teams. Here are several real-world examples and case studies where teams have successfully implemented these technologies to enhance their workflows:



### GitHub and AI-powered Code Reviews:

GitHub, a leading platform for version control and collaboration, has integrated AI to assist with code reviews. For instance, GitHub's "Dependabot" automatically raises pull requests to update dependencies, helping to prevent security vulnerabilities and ensure that projects are up-to-date. This automation reduces the manual effort required for maintaining applications and allows developers to focus on more complex tasks.



### Microsoft's Use of AI in Software Development:

Microsoft has been at the forefront of using AI to optimise its software development processes. The company has developed AI-powered tools like "IntelliCode," which provides AI-assisted code completions and makes recommendations based on thousands of open-source projects. This tool helps developers write code more efficiently and with fewer errors.



### Facebook's Use of Machine Learning for Performance optimisation:

Facebook employs machine learning to optimise the performance of its applications. For example, the company uses predictive algorithms to pre-load content that users are likely to access next, reducing latency and improving user experience. This approach leverages emerging technologies to enhance the performance of their applications without requiring extensive manual intervention.



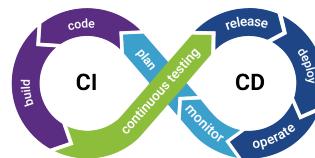
### Google's Machine Learning for Android Development:

Google has introduced machine learning into the Android development process with tools like "ML Kit." This allows developers to integrate machine learning models into their applications without extensive expertise in ML. By providing pre-trained models for common tasks, Google has made it easier for developers to create intelligent applications, thus optimising the development process.



### Automated Testing with AI:

Companies like Testim have developed AI-powered tools for automated testing. These tools use machine learning to identify UI elements and can adapt to changes in the application, reducing the maintenance required for test scripts. This automation helps development teams to catch bugs earlier and speeds up the testing process.



### Continuous Integration/Continuous Deployment (CI/CD) with Machine Learning:

CI/CD pipelines are being enhanced with machine learning to predict the success of builds and

deployments. For example, tools can analyse historical data to identify patterns that lead to failed builds, allowing teams to address potential issues before they cause delays.



### Netflix's Personalisation Algorithms:

Netflix uses sophisticated machine learning algorithms to personalise content recommendations for its users. By optimising the content delivery system, Netflix ensures that users have a seamless experience, which in turn reduces churn and support costs. The company's use of emerging technologies in this way has become a case study in how to leverage AI for business advantage.



### Salesforce's Einstein AI:

Salesforce's Einstein AI platform provides developers with tools to build AI-powered applications. This platform democratises AI by offering pre-built models and an easy-to-use interface, allowing development teams to quickly integrate intelligent features into their applications.

---

These examples demonstrate how emerging technologies, particularly AI and machine learning, are being used to optimise various aspects of application system development and maintenance. By automating routine tasks, providing intelligent recommendations, and enhancing performance, these technologies enable development teams to focus on innovation and delivering value to their users.

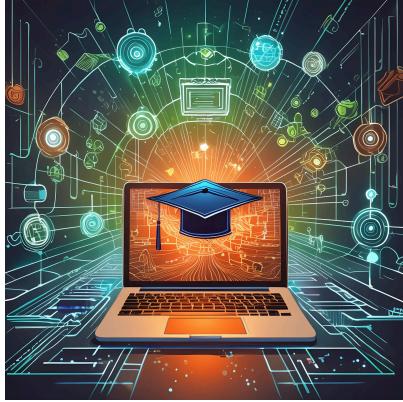
## Agile and DevOps methodologies and tools for streamlining application system development and maintenance with emerging technologies

Agile and DevOps methodologies have revolutionised the way teams approach application system development and maintenance, emphasising flexibility, collaboration, and continuous improvement. **Agile methodologies**, such as Scrum or Kanban, break down development into small, manageable chunks called sprints, allowing teams to adapt to changes quickly and deliver value to customers more frequently. DevOps, on the other hand, focuses on bridging the gap between software development and IT operations, promoting practices like **continuous integration (CI)** and



**continuous deployment (CD)** to streamline the delivery of applications and services. When combined with emerging technologies, such as AI-driven analytics, cloud-native architectures, and containerisation, Agile and **DevOps** methodologies can further enhance efficiency and effectiveness. For instance, AI can automate testing and provide predictive insights into potential issues, while cloud-native technologies and containers can facilitate faster deployment and scaling of applications. These technologies not only accelerate the development process but also improve the maintainability and resilience of application systems, aligning with the core principles of Agile and DevOps.

## Strategies for upskilling and reskilling development teams to effectively leverage emerging technologies in application system design and implementation



Upskilling and reskilling development teams are critical strategies for effectively leveraging emerging technologies in application system design and implementation. Organisations should focus on creating a **culture of continuous learning**, encouraging team members to stay abreast of the latest technological advancements. This can be facilitated through workshops, webinars, and conferences that expose teams to new tools, frameworks, and methodologies. Additionally, providing access to **online courses and certifications** in emerging technologies can help team members acquire the necessary skills at their own pace. It's also important to foster an environment where experimentation is encouraged, allowing developers to apply their new skills on small projects or proofs of concept before integrating them into larger systems.

Another effective strategy is to establish **cross-functional teams** that include members with expertise in emerging technologies. This not only helps in knowledge transfer but also in creating a collaborative atmosphere where traditional developers can learn from those who are already proficient in new technologies. **Mentorship programs** can be particularly beneficial, pairing experienced developers with emerging technology specialists to ensure a smooth transition. Furthermore, organisations should consider **partnering with educational institutions** or hiring consultants who specialise in emerging technologies to provide targeted training and guidance. By investing in these upskilling and reskilling initiatives, development teams can become adept at integrating cutting-edge technologies into their work, ultimately leading to more innovative and efficient application system design and implementation.

## Metrics and KPIs for measuring the impact of emerging technologies on application system development and maintenance efficiency, quality, and time-to-market



Measuring the impact of emerging technologies on application system development and maintenance requires the establishment of clear metrics and Key Performance Indicators (KPIs) that can quantify efficiency, quality, and time-to-market. One **set of metrics** can focus on development efficiency, such as the reduction in development time, the increase in code velocity, and the improvement in developer productivity. For instance, the adoption of low-code/no-code platforms can be evaluated by the decrease in the average time to develop new features or the enhancement in the number of features released per cycle.

Similarly, the use of **AI-driven code analysis tools** can be measured by the reduction in bug resolution time or the decrease in the number of code revisions needed before deployment.

**Quality metrics** are equally important and can include the reduction in defect rates, the improvement in code stability, and the enhancement of user experience. The integration of automated testing frameworks and continuous integration/continuous deployment (CI/CD) pipelines can be assessed by the decrease in the number of bugs found in production or the increase in test coverage. Additionally, the adoption of emerging technologies like **machine learning for predictive maintenance** can be measured by the reduction in downtime or the increase in system reliability. These metrics help in ensuring that the introduction of new technologies not only accelerates development but also maintains or improves the quality of the application system.

**Time-to-market metrics** are crucial for businesses seeking to gain a competitive edge. These can include the reduction in time from concept to market, the acceleration of feature release cycles, and the responsiveness to market changes. The impact of emerging technologies on time-to-market can be measured by the decrease in the overall development lifecycle, the ability to deliver updates and new versions more frequently, and the speed at which the organisation can adapt to new market demands or regulatory changes. By tracking these KPIs, organisations can ensure that their investment in emerging technologies is effectively translating into tangible business outcomes, such as faster innovation cycles and a quicker return on investment.



This activity is complete when you have

- Engaged with the AI tutor in the PredictGuard case study and participated in class discussion to share your experiences and learn from others.

- Documented your analysis and recommendations for the PredictGuard case study in a short report (1-2 pages, or a copy of the chat transcript), which will form part of your **portfolio** (<https://lms.griffith.edu.au/courses/24045/pages/building-a-portfolio-for-assignment-2>)..
- Applied the concepts of Activities 8.1 and 8.2 to your **application system design report** (<https://lms.griffith.edu.au/courses/24045/assignments/93487>)..