Frankfurt University
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– Faculty of Computer Science and Engineering –

Project Cloud Computing

LowTech GmbH

Milestone 2

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Contents

1 1. DevOps

DevOps is a culture and methodology aimed at improving collaboration between development (Dev) and operations (Ops). It includes:

- **Automation:** Processes are automated from code creation to deployment (e.g., CI/CD pipelines).
- **Collaboration:** Developers and operations teams work together on infrastructure and code.
- **Continuous Improvement:** Regular iterations allow for faster response to customer requirements.
- **Monitoring and Feedback:** Systems are monitored, and feedback is utilized to identify and resolve issues early.

2 2. Cloud Native

Cloud Native refers to an approach where applications are designed specifically for the cloud. Key characteristics include:

- **Microservices:** Applications are divided into small, independent services that can be developed, deployed, and scaled separately.
- **Containerization:** Each service runs in a container (e.g., Docker), ensuring portability and consistency.
- **Orchestration:** Tools like Kubernetes manage containers, handle deployment, scaling, and ensure high availability.
- **Serverless Computing:** Some components can run without dedicated servers, where costs align with actual usage.

3 Example: An Online Shop

Let us consider an online shop developed using DevOps and Cloud Native principles.

Traditional Application

In traditional software development approaches, such an application is typically structured as a monolith, encompassing all components—user interface, backend logic, and database—within a single codebase. This monolithic design poses significant challenges for scalability and maintainability. For instance, deploying updates or new features requires redeployment of the entire application, and scaling under high traffic involves replicating the entire monolith, even if only a specific component experiences increased load.

3.1 Cloud Native Application

The online shop is divided into multiple **microservices**, such as:

1. **User Management** (login/registration).
2. **Product Catalog** (viewing and searching products).
3. **Shopping Cart** (storing items in the cart).
4. **Order Management** (managing orders and payments).

How DevOps and Cloud Native Improve the Application:

1. **Microservices in Containers:** Each microservice is deployed in its own container. For example, the product catalog runs in one container, and the shopping cart in another. Containers can be updated or scaled independently.
2. **Automation through DevOps:** CI/CD pipelines ensure that changes to a microservice are automatically tested and deployed. For instance, if a developer improves the shopping cart functionality, the new code is automatically tested and deployed to the cloud.
3. **Scalability during High Load:** When many users browse the product catalog simultaneously, Kubernetes can automatically start more containers for this service. Other services (e.g., user management) remain unaffected, ensuring optimal resource usage.
4. **Monitoring and Feedback:** Tools like Prometheus and Grafana monitor the application state. If, for example, the shopping cart service slows down, an alert is triggered immediately to facilitate prompt intervention.
5. **Serverless Functions with Google Cloud Functions:** Tasks like sending order confirmations can be automated with Google Cloud Functions, reducing complexity and costs while integrating with other Google services.

4 Migration Plan

This migration plan outlines the steps and considerations for transitioning the various departments and their systems to the specified configurations. Each department's migration plan incorporates tailored strategies, aligned with industry-standard migration approaches, such as Rehost, Replatform, Repurchase, Refactor/Rearchitect, Retain, and Retire.

4.1 Finance Department

Current Systems: SAP Software and Legacy Application.
Migration Strategy: Rehost and Repurchase

- **Rehost (Short-Term):** The Legacy Application will be hosted on Google Cloud Compute Engine using virtual machines (VMs) for the next three years. This ensures compatibility with legacy operating systems while leveraging cloud infrastructure for reliability and scalability.
- **Repurchase (Long-Term):** After the three-year period, the department will transition entirely to SAP's cloud-based solutions (e.g., SAP S/4HANA hosted on Google Cloud). This aligns with the department's preference for SAP software and modernizes their operational platform.
- **Integration:** Middleware will facilitate communication between the Legacy Application and SAP software during the transition period.
- **Preparation for SAP Transition:** During the three-year transition phase, data migration and system alignment activities will be conducted to ensure a seamless migration to the SAP platform.

4.2 HR Department

Current Systems: Existing HR System, including HR Software, Office Suite, and Shift Management functionality.
New System: Custom-developed HR Software from our company.
Migration Strategy: Refactor and Replace

- **Refactor:** The newly developed HR Software will be designed as a cloud-native application utilizing Google Kubernetes Engine (GKE) for container orchestration and scaling. It will consolidate existing functionalities, such as HR management and shift planning, into a unified platform.
- **Replace:** The existing HR System will be gradually phased out as the new software is rolled out. Data migration will ensure that historical data from the current system is preserved and integrated into the new platform.
- **Deployment:** The application will run seamlessly across cloud, server, and client environments, ensuring high availability and accessibility for HR staff.
- **Support and Training:** Comprehensive training sessions will be provided for HR staff to ensure smooth adoption. Documentation and user guides will accompany the transition.
- **Integration:** The new HR Software will integrate with the Office Suite to maintain workflows and facilitate reporting, while offering additional enhancements for shift management.

4.3 Production Department

Current Systems: Existing Production Environment with Reporting Management and Shift Management functionality.
New System: Custom-developed Shift Management and Reporting Management System from our company.
Migration Strategy: Refactor and Replace

- **Refactor:** The newly developed system will be designed as a cloud-native application utilizing Google Cloud Run for serverless computing and Google Kubernetes Engine (GKE) for scalability. The new solution will modernize existing functionalities while incorporating additional features based on user feedback.
- **Replace:** The existing system will be gradually replaced. Historical data and configurations from the current system will be migrated to the new platform to ensure continuity and usability.
- **Integration:** APIs and middleware will ensure the new system integrates seamlessly with other internal systems and workflows in the Production environment.
- **Pilot Phase and Feedback:** A pilot deployment will be conducted in a controlled production setting. Feedback from production teams will be used for iterative enhancements before full rollout.
- **Support and Training:** Production staff will receive training on the new system to minimize disruptions during the transition. Ongoing support will be available to address potential challenges.

4.4 Supply Management

Current Systems: Existing Supply Management System with SCM functionality.
New System: Commercial-off-the-shelf (COTS) SCM software from a vendor.
Migration Strategy: Replace

- **Replace:** The existing SCM system will be phased out and replaced with the new COTS solution. A comprehensive plan for data migration will be implemented to ensure historical supply chain data is preserved and transitioned into the new system.
- **Integration:** The COTS SCM software will be configured to integrate seamlessly with other internal systems, including production, warehouse, and quality management, to maintain end-to-end supply chain visibility.
- **Customization:** Vendor-provided customization options will be leveraged to align the new software with the specific operational requirements of the Supply Management department.
- **Training and Support:** Supply management staff will undergo training on the COTS SCM software to ensure a smooth transition. Vendor support and internal IT assistance will be available during the implementation phase.
- **Implementation Phases:** The rollout will follow a phased approach, beginning with a pilot deployment in select supply chain operations before full-scale adoption.

4.5 Quality Management Department

Current Systems: Existing Quality Management (QM) software.
New System: COTS Quality Management (QM) software for Windows systems from a vendor.
Migration Strategy: Replace

- **Replace:** The existing QM software will be replaced with a new COTS solution. Data from the current system will be migrated to ensure continuity of quality records and compliance data.
- **Deployment:** The new QM software will be deployed on Windows Server virtual machines hosted on Google Compute Engine, ensuring compatibility and scalability.
- **Integration:** APIs will be utilized to integrate the new QM software with other systems, such as production and supply management, enabling centralized reporting and streamlined quality workflows.
- **Phased Rollout:** A phased implementation will be adopted, starting with a pilot in a limited scope before extending to all quality management operations.
- **Training and Support:** Training sessions will be provided for the Quality Management team, and vendor support will be leveraged to address challenges during the transition.

4.6 Warehouse Department

Current Systems: Existing Warehouse Management System and Deliforce (on-premise or on-demand).
New Systems:

- Custom-developed Warehouse Management System from our company.
- Continue using Deliforce (on-premise or on-demand).

Migration Strategy: Replace, Refactor, and Retain

- **Replace:** The existing Warehouse Management System will be replaced with the new custom-developed system. Data migration will ensure continuity, and historical records will be preserved.
- **Refactor:** The new Warehouse Management System will be developed as a cloud-native application, utilizing Google Cloud Storage for secure data handling and Google Kubernetes Engine (GKE) for scalable deployment.
- **Retain:** Deliforce will continue to operate in its current configuration, either on-premise or on-demand, and will be integrated with the new Warehouse Management System to maintain operational continuity.
- **Integration:** APIs will be designed to ensure seamless communication between the new Warehouse Management System, Deliforce, and other relevant systems, such as supply chain management and quality management.
- **Training and Support:** Warehouse staff will receive training to familiarize themselves with the new system. Support will be available during and after deployment to address any challenges.
- **Phased Rollout:** The new system will be introduced in phases, starting with a pilot implementation to minimize disruptions and gather feedback for iterative improvements.

4.7 Sales Department

Current Systems: CRM system (shared with Operations and Customer Service), Lead Management Business Analytics, Office Suite, and Tableau (Market Development).
New Systems:

- Lead Management system (retained).
- Additional COTS software.

Migration Strategy: Refactor and Retain

- **Retain:** The current Lead Management system will continue to be used as-is. Data will be migrated if necessary to ensure smooth integration with the new systems.
- **Refactor:** The new COTS software will be integrated with the existing systems, enhancing capabilities across the Sales, Operations, and Customer Service departments. Integration with the shared CRM system will ensure a unified view of customer data.
- **Integration:** APIs will be used to connect the new COTS software with the shared CRM, Tableau, and other systems. This will ensure seamless access to customer information, reporting, and analytics for the Sales team.
- **Support and Training:** Sales, Operations, and Customer Service staff will receive training on the new COTS software and its integration with the shared CRM, to enhance collaboration and efficiency across departments.
- **Phased Rollout:** The deployment of the new software will be gradual, beginning with testing in one department before scaling to all users. Feedback will be collected to improve the implementation.

4.8 Facility Management Department

Current Systems: Proprietary software on-premise with REST-API.
New Systems: Continue using proprietary software with enhancements.
Migration Strategy: Retain and Refactor

- **Retain:** The current proprietary software will continue to be used as-is. The system's core functionality will remain unchanged.
- **Refactor:** Enhancements will be made to the existing software to improve its integration with other systems, leveraging cloud capabilities. A migration to a cloud-based infrastructure (e.g., Google Cloud) for hosting the software may be considered to enhance scalability and availability while maintaining the REST-API for integration.
- **Integration:** The proprietary software will be integrated with other systems using APIs, ensuring seamless data exchange across departments such as HR, Sales, and Operations. This will enable efficient facility management and better decision-making.
- **Deployment:** The software will continue to run on-premise, with the option for cloud hosting if necessary for future scalability. The transition will be gradual to avoid disruption of facility operations.
- **Training and Support:** Facility Management staff will receive training on the new features and

integration points to ensure they can fully leverage the system's capabilities.

4.9 Webshop Department

Current Systems: CMS for webshop, integrates with Customer Service and Information Management (Jira Service Desk, Build Server, Development Server, Analysis).
New System: Newly developed website with new technology.
Migration Strategy: Refactor and Retain

- **Retain:** The current CMS will continue to be used for the existing webshop functionality until the new website is fully developed and ready for deployment. The integration with Customer Service and Information Management will remain in place to ensure continuity in communication and operations.
- **Refactor:** The new website will be developed using modern technologies (e.g., React frontend, Python backend) to provide enhanced performance, scalability, and user experience. It will be integrated with existing systems such as Jira Service Desk, Build Server, Development Server, and Analysis tools.
- **Integration:** APIs will be used to ensure seamless integration between the new website and Customer Service tools (e.g., CRM), as well as with Information Management systems (e.g., Jira, Build and Development Servers). This will enable streamlined workflows and data sharing across departments.
- **Deployment:** The new website will be gradually rolled out to minimize disruption. Initially, it will run in parallel with the existing CMS, with full migration planned once the new system is stable.
- **Training and Support:** Training will be provided for both the web development team and Customer Service staff to ensure smooth adoption of the new system. Continuous support will be available to address any issues during and after deployment.

5 Service Models

Application/Department	Cloud Service Model
Finance Department (Legacy SAP)	IaaS (Virtual Machines on Private Cloud for 3 years)
Finance Department (SAP S/4HANA)	SaaS (Cloud-based SAP S/4HANA after 3 years)
HR Department (Custom HR Software)	PaaS (Google Kubernetes Engine for container orchestration)
Production Department (Shift Management & Reporting System)	PaaS (Google Cloud Run for serverless computing, Google Kubernetes Engine)
Supply Management (COTS SCM Software)	SaaS (Vendor-hosted COTS Software)
Quality Management (COTS QM Software)	SaaS (Vendor-hosted COTS Software)
Warehouse Department (Custom Warehouse Management System)	PaaS (Google Kubernetes Engine for cloud-native application)
Sales Department (CRM, Lead Management)	SaaS (Cloud-based CRM and Lead Management Systems)
Webshop Department (Website and CMS)	PaaS (Web hosting via cloud platforms, possibly Google Cloud)
Facility Management (Proprietary Software)	IaaS (Private Cloud Hosting or Cloud-based Infrastructure)
Deliforce (Warehouse Management)	SaaS (Cloud-based system or retained on-premise)

Table 1: Cloud Service Model Allocation for Applications

6 Cloud Transformation Plan

This Cloud Transformation Plan outlines the steps and considerations for migrating various departments and their systems to appropriate cloud setups. The plan takes into account different cloud models, including Private Cloud, Public Cloud, and Hybrid Cloud, and assigns the suitable migration strategy to each system.

6.1 Private Cloud Context

In a Private Cloud setup, the organization retains full control over its cloud infrastructure, which is typically hosted either on-premises or in a dedicated data center. This is particularly advantageous for critical or sensitive applications that must comply with strict security and regulatory requirements. Below is the migration strategy for relevant systems and applications to a Private Cloud.

6.1.1 Applications Hosted in a Private Cloud:

- **Facility Management:** The existing proprietary software with a REST API will continue to be used, but it may be migrated to a Private Cloud infrastructure to improve scalability, availability, and security.
- **Reason for Private Cloud:** Facility Management may handle sensitive infrastructure data that must remain within a controlled environment to ensure better data protection.
- **Migration Steps:** The current software may be refactored to improve integration with other systems, with the hosting infrastructure being moved to a Private Cloud platform.
- **Finance Department:** The legacy SAP software will temporarily be hosted on a Private Cloud (with virtual machines) to maintain compatibility with older operating systems while benefiting from the advantages of cloud infrastructure.
- **Reason for Private Cloud:** Financial applications often face strict compliance requirements and benefit from dedicated resources for better performance and security.
- **Migration Steps:** The SAP infrastructure will be set up on a Private Cloud using VMs to ensure sensitive financial data remains within a controlled environment.

6.2 Public Cloud Context

In a Public Cloud setup, the organization uses cloud services provided by third-party providers (such as Google Cloud, AWS, Azure) to host infrastructure and applications. The Public Cloud generally offers cost-effective, flexible, and scalable solutions, ideal for applications that do not have stringent compliance requirements and can benefit from shared resources.

6.2.1 Applications Hosted in a Public Cloud:

- **HR Department:** The new cloud-native HR software will be deployed in a Public Cloud infrastructure, using Google Kubernetes Engine (GKE) for container orchestration and scaling.
- **Reason for Public Cloud:** Cloud-native applications benefit from scalability, high availability, and flexibility provided by public cloud environments.
- **Migration Steps:** The HR software will be developed and deployed on Google Cloud, with containerized microservices efficiently managed through GKE.
- **Production Department:** The newly developed, cloud-native Shift Management and Reporting System will be deployed in the Public Cloud using Google Cloud Run and GKE.
- **Reason for Public Cloud:** The scalability and serverless options provided by Google Cloud Run are particularly suited for production environments that require rapid scaling.
- **Migration Steps:** Implementation of the new system on Google Cloud Run and integration with other systems via APIs.
- **Supply Management:** The new COTS SCM software will be fully deployed in the Public Cloud (Google Cloud) to optimize SCM functionalities.
- **Reason for Public Cloud:** COTS solutions work well in Public Cloud environments, as these solutions often require extensive scalability and support from the cloud provider.
- **Migration Steps:** Deployment of the COTS SCM software on Google Cloud and ensuring integration with internal systems.
- **Sales Department:** CRM and lead management systems, as well as new COTS software solutions, will be hosted in the Public Cloud to enable real-time access and improve collaboration.
- **Reason for Public Cloud:** The Public Cloud provides seamless integration and scalability for CRM and lead management systems.
- **Migration Steps:** Migration of the CRM platform to Google Cloud and integration of existing systems into the cloud via APIs.

6.3 Hybrid Cloud Context

A Hybrid Cloud model combines Private Cloud and Public Cloud infrastructures, providing greater flexibility and optimized solutions. In a Hybrid Cloud scenario, applications that have strict compliance or legacy system requirements remain in the Private Cloud, while applications that need scalability and cost savings are migrated to the Public Cloud.

6.3.1 Applications That Can Be Used in a Hybrid Cloud Setup:

- **Finance Department:**
  - **Private Cloud:** The legacy SAP software will remain in the Private Cloud for the transition period to meet security requirements.
  - **Public Cloud:** The future SAP cloud solution (e.g., SAP S/4HANA) will be deployed in the

Public Cloud to modernize the department.

  - **Hybrid Setup:** Middleware will enable communication between the legacy SAP software in the Private Cloud and the future SAP solution in the Public Cloud.

- **HR Department:**
  - **Private Cloud:** The existing HR system may temporarily remain in the Private Cloud until the new software is fully deployed.
  - **Public Cloud:** The new HR software will be deployed in the Public Cloud with cloud-native technologies such as Google Kubernetes Engine.
  - **Hybrid Setup:** A hybrid setup allows a gradual migration from the existing HR system in the Private Cloud to the new software in the Public Cloud.
- **Warehouse Department:**
  - **Private Cloud:** Deliforce will continue to run in the Private Cloud to ensure operational stability.
  - **Public Cloud:** The newly developed Warehouse Management System will be deployed in the Public Cloud to support scalability and future growth.
  - **Hybrid Setup:** Integration between Deliforce (Private Cloud) and the new Warehouse Management System (Public Cloud) ensures seamless operations.
- **Sales Department:**
  - **Private Cloud:** Sensitive customer data and lead management information may remain in the Private Cloud for enhanced security.
  - **Public Cloud:** COTS software and CRM tools will be deployed in the Public Cloud to provide better scalability and flexibility.
  - **Hybrid Setup:** A hybrid setup enables the retention of secure, private data in the Private Cloud while leveraging the benefits of the Public Cloud for CRM, analytics, and market development tools.
- **Webshop Department:**
  - **Private Cloud:** The existing CMS may continue to run in the Private Cloud if there are concerns about security or compliance, especially for payment processing.
  - **Public Cloud:** The newly developed website will be deployed in the Public Cloud to take advantage of modern technologies and optimize performance and scalability.
  - **Hybrid Setup:** The hybrid cloud strategy allows the parallel operation of the existing CMS (Private Cloud) and the new website (Public Cloud) to ensure a smooth migration and efficiency.

6.4 Conclusion

- **Private Cloud:** Best suited for sensitive data or legacy systems requiring high control and security.
- **Public Cloud:** Ideal for cloud-native applications and systems that require high scalability, flex-

ibility, and modern cloud services.

- **Hybrid Cloud:** Offers a combination of both approaches, providing flexibility and a gradual migration of legacy systems to the Public Cloud.

This migration plan ensures that each system is migrated to the appropriate cloud environment based on its specific requirements, while taking full advantage of the respective cloud infrastructure benefits.