**Constraints:**

**1. Technical Constraints**

**Platform and Software Compatibility:**

1. The system must be developed to work as a plug-in for the existing registration system that operates with the Oracle database.
2. The system must be compatible with existing technology, including Java and C, as most functions were developed using these languages.
3. The system must be portable and run on various devices like mobile phones, tablets, and desktops.

**Scalability:**

1. The current system is designed to handle 10 million vehicles, but it needs to scale to support more than 30 million vehicles in the next 10 years.

**System Integration:**

The iQVR system must integrate with external systems such as:

1. qPay system for payment processing.
2. The vehicle manufacturer’s system for VIN verification.
3. Qatar Trade Service for checking the vehicle’s import records.
4. Insurance companies and authorized workshops for insurance and fitness certificates.

Integration with these systems must be seamless, and the iQVR system should receive acknowledgment receipts from each external system.

**System Modularity and Distribution:**

1. The system could be distributed in the future, with different components running on different machines in different locations.
2. The system components should be loosely coupled and focused to enable future upgrades and modifications without affecting the entire system.

**Database Dependency:**

1. The system must use Oracle for data management, limiting flexibility with other database systems.

**Backup and Availability:**

1. Backup modules must be managed to ensure system availability to users most of the time.

**2. Operational Constraints**

**Staffing:**

1. The traffic police department can only hire 10 new technical staff to manage and support the system.
2. Only one system administrator will manage the entire automated process, which limits the administrative capacity.

**Server Limitations:**

1. The department has a budget for only 20 new servers, which limits the infrastructure expansion possibilities.

**Development Timeframe:**

1. The first version of the system must be completed within three months to avoid penalties for the department, as the system needs to be operational within 12 months.

**Maintenance and Upgrades:**

1. The system should allow modifications and upgrades to some functions without changing the interfaces or affecting other components.

**3. Legal and Regulatory Constraints**

**Data Privacy and Confidentiality:**

1. Vehicle data, ownership details, and core vehicle information are confidential and must not be exposed to general users.
2. These sensitive data elements need to be protected by separating them from high-level user interfaces.

**Compliance with Traffic Laws:**

1. The system must adhere to Qatar’s traffic laws and vehicle registration regulations.
2. Accident reports and fine management must align with existing traffic policies, including red-light offences.

**Authorized Users Only:**

1. Only vehicle owners, insurance companies, authorized workshops, and traffic police have access to specific services, ensuring limited exposure of certain functions.

**Insurance and Fitness Certificate Validation:**

1. Insurance and fitness certificates must be provided by authorized entities and stored in compliance with local regulations.

**4. Performance Constraints**

**System Responsiveness:**

1. The system should handle vehicle registration renewals, ownership transfers, and other services in real time, ensuring low latency and efficient processing.

**Transaction Load Handling:**

1. The system must be able to handle a large number of transactions concurrently as the number of vehicles increases.
2. Payment and billing functions must be efficient, especially when handling traffic fines and invoices.

**5. User Constraints**

**Login and Authentication:**

1. User login functionality (for vehicle owners, insurance companies, and workshops) is assumed to be handled by an external system, and is not within the development scope of the iQVR system.

**User Interface Complexity:**

1. The system must be user-friendly for non-technical users like vehicle owners, insurance companies, and workshops, ensuring minimal technical knowledge is required for its use.

**6. Security Constraints**

**Credit Card Security:**

1. Payment transactions, especially involving credit card details, must comply with security standards, including encrypting sensitive information.
2. qPay system must validate the credit card before any transaction is approved.

**Authorization and Access Control:**

1. Only authorized personnel (system administrators, traffic police, and authorized users) should have access to critical system functions like red-light offence reports and vehicle confiscation orders.

**NFR:**

**1. Scalability**

• The system shall currently support 10 million vehicles.

• The system shall handle the growing number of transactions (e.g., registrations, renewals, penalties).

• The System shall allow horizontal scaling (adding more servers or distributed systems) to meet demand.

**2. Performance**

• The system shall display search results to the user within 0.5 seconds of the query submission, assuming a stable broadband connection.

• The system shall Response for critical user interactions (e.g., registering vehicles, transferring ownership) within 2 seconds.

• The system shall support up to 10,000 concurrent users with minimal degradation in performance.

• The system’s Batch processes (e.g., daily updates, backups) shall not affect online transaction speeds.

**3. Security**

• The system shall protect Vehicle registration details, owner data, and core system data with strong encryption (e.g., AES-256).

• The system shall allow only authorized users (e.g., vehicle owners, workshops, traffic police) to access specific features. Implement multi-factor authentication (MFA) for sensitive functions.

• The system shall separate core data (e.g., vehicle ownership details) from user-facing interfaces to avoid direct exposure.

**4. Availability**

• The system shall be available 98.6% of the time, including during peak hours.

• Downtime within normal working hours shall not exceed 7 seconds in any one day.

• Redundancy and failover mechanisms shall be in place to ensure minimal downtime in case of server failure.

• Regular backups of critical data shall be conducted daily, with an automated restoration process for disaster recovery.

**5. Portability**

• The system shall be accessible across various platforms (e.g., mobile phones, tablets, desktops).

• The interface shall be responsive and adapt to different screen sizes and resolutions.

**6. Interoperability**

• The system shall integrate seamlessly with the external systems mentioned (insurance companies, workshops, vehicle manufacturers, Qatar Trade Service).

• The system shall use standard communication protocols (e.g., HTTPS, RESTful APIs) to ensure compatibility with third-party services.

• The system shall work smoothly with qPay for payment processing without any noticeable delay.

**7. Maintainability**

• The system shall be modular, with clearly defined components for each function (registration, payments, penalties) to allow easy upgrades and modifications.

• The codebase shall follow clean coding practices, enabling future developers to modify or add features without impacting the existing system.

**8. Reliability**

• The system shall be fault-tolerant, meaning it should continue operating smoothly even when individual components fail.

• Any errors during critical operations (e.g., payments, transfers) shall be handled gracefully, with clear error messages and automatic retries where appropriate.

**9. Data Integrity**

• The system shall ensure that all vehicle registration data and transaction details are accurate, with no loss or corruption of data during updates or transfers.

• Strong validation checks shall be in place to prevent invalid or duplicate entries for VINs, QIDs, and other essential data.

**10. Compliance**

• The system shall comply with Qatar's data protection regulations regarding the handling of personal data (e.g., owner names, QIDs).

• The system shall consider Compliance with international standards for vehicle registration systems.

**11. User Experience (Usability)**

• The system shall be intuitive and easy to navigate, with clear instructions for vehicle owners, workshops, and insurance companies.

• Error handling shall be user-friendly, providing detailed information on how to resolve any issues (e.g., unpaid fines, missing documents).

• The system shall offer multi-language support, especially Arabic and English, to cater to all users in Qatar.

**12. Modularity and Extensibility**

• The system shall be designed to allow new functionalities to be added in the future without major overhauls.

• Each component shall operate independently, enabling developers to modify or remove specific sections (e.g., penalties, registration) without affecting the entire system.