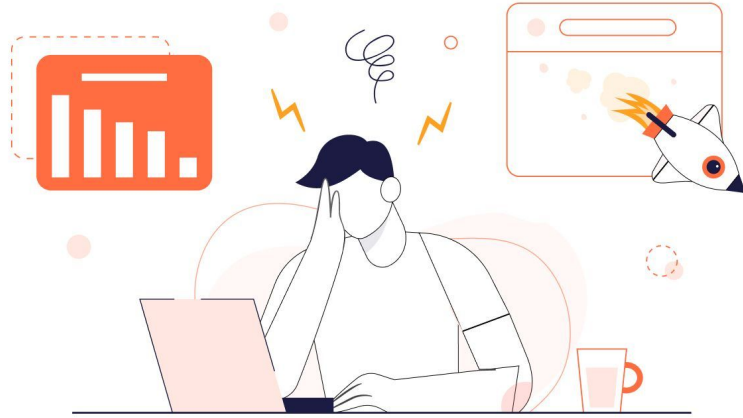# Software Requirement Readiness Levels (SrRL)

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Computer Engineering, KMITL

bit.ly/**SRRL**

Your software is ready for users! Are you sure?

- Some Bugs ?
- Slow response ?
- Errors ?
- Users say OK?

Have all requirements been **tested** already?

Ref: https://www.neoito.com/blog/6-major-reasons-why-software-projects-fail-and-how-to-avoid-them/

Introduction

This paper introduces software requirement readiness levels (SrRL), which is a definition to determine the readiness level of each software requirement of a software system. Our proposed SrRL provides the definitions of 9 levels that are applied from the concept of technology readiness levels (TRL), together with scenarios and recommendations to achieve each level.
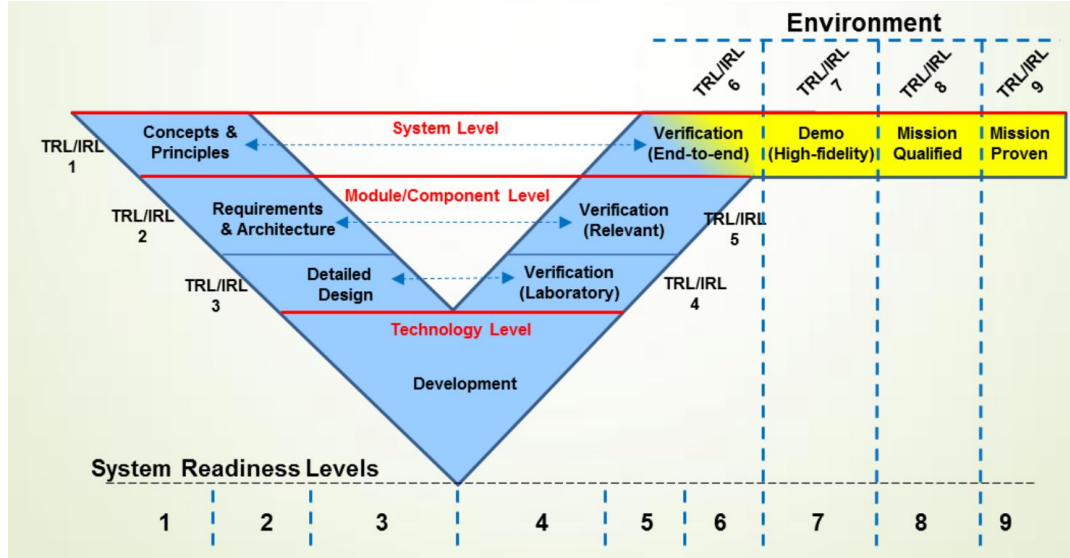
The proposed concept, SrRL, can be a guideline for inspection committees, stakeholders, product owner, development team, etc. to accept software systems that satisfy their requirements.

Agenda

- Background
- **SrRL**
- Guidelines
- Examples
- Summary

Background

Technology Readiness Levels (TRL)

1) Concept & Principle
2) Requirement & Architecture
3) Detailed Design

4) Verification (Laboratory)
5) Verification (Relevant)
6) Verification (End-to-End)

7) Demo (High Fidelity)

8) Mission Qualified
9) Mission Proven

Ref: https://ndiastorage.blob.core.usgovcloudapi.net/ndia/2016/systems/18832_DonaldYork.pdf

Software Requirement Readiness Levels
(SrRL)

Software Requirement Item

can be each of ...

- Feature/Function
- Use Case
- User Story
- Task

Flows in each Requirement Item

- **Key Flow(s)**
- **Alternative Flows**
  - **Regular Variance**
  - **Exceptional Flow (Error)**
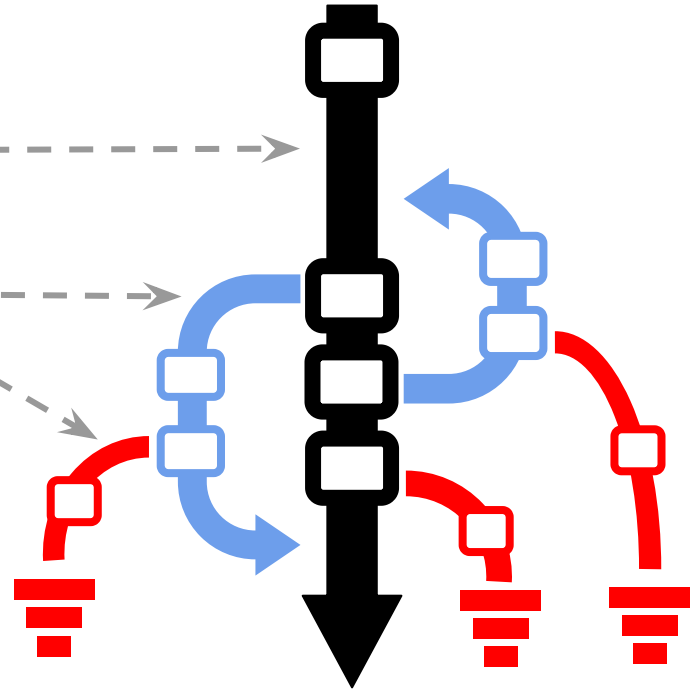
Example: Requirement Item: Buy Online Products

All Flows include:
- **Key Flow(s)**
  - select products → add to a cart → check out a cart → select a payment method → pay → get confirm msg
- **Alternative Flows**
  - **Regular Variance**
    - select products → add to a cart → login → check out a cart → select a payment method → pay → get a confirm message
    - select products → add to a cart → check out a cart → add a coupon code → select a payment method → pay → get a confirm message
  - **Exceptional Flow (Error)**
    - products are not available immediately during payment
    - payment fail
    - user makes a cancellation
    - user closes a browser by accident during payment
    - internet connect problem found during payment
    - a coupon code is invalid
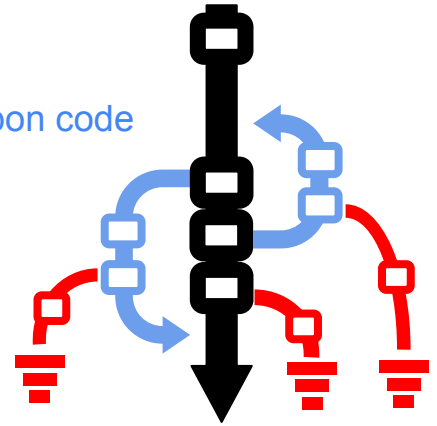
Software Requirement Readiness Levels (1-3)

Level	TRL	SrRL Activities
1	Concept & Principle	● Key flows are analyzed
2	Requirement & Architecture	● Detailed requirement Analysis of all possible flows ● Acceptance criteria ● Context diagram (between a developing system and external systems)
3	Detailed Design	● UX/UI (Mockup Prototype) ● System Modelling e.g. UML, DFD, ERD, etc.

Design is Ready for Development

Software Requirement Readiness Levels (4-6)

Level	TRL	SrRL Activities
4	Verification (Laboratory)	● Key flows are unit tested ● Key flows are integration tested in a development environment.
5	Verification (Relevant)	● Key flows are integration tested and system tested in a test environment.
6	Verification (End-to-End)	● Key flows are system tested, end-to-end tested, and user acceptance tased in a pre-production environment with real cases, real data, and real external systems

Key Flows are Ready for Demonstration to Stakeholders

Software Requirement Readiness Levels (7)

Level	TRL	SrRL Activities
7	Demo (High Fidelity)	- All flows are unit tested. - All flows are integration tested, and system tested, and end-to-end tested in a pre-production environment with real cases, real data, and real external systems. - In other words, all flows are passed levels 4, 5, and 6.

The Requirement is Ready for Pilot Users

Software Requirement Readiness Levels (8-9)

Level	TRL	SrRL Activities
8	Mission Qualified	● Every flow are non-functional tested in a pre-production environment. 　○ e.g. performance, availability, security, etc. ● Some standards are verified (if any).
9	Mission Proven	● All flows are installed in a production environment using an automatic process.

The Requirement is Ready for Delivery to Customers

SrRL: Guidelines

Priority of Software Requirement Items

- **Critical** (Required)
  - Requirements that have a high value to the goal,
    - e.g. checkout a shopping cart, auction, decision-making reports ...
- **Standard** (Mandatory)
  - Requirements that support the critical requirements,
    - e.g. sign up, login, logout, forgot password, support reports, ...
- **Optional** (Nice to Have)
  - Requirements that have a low impact to the goal,
    - e.g. user profile avatar, about us page, nice-to-have reports ...

An Example Software System (18 req items)

Critical Requirements

- [R01] Browsing Products, [R02] Adding to Cart, [R03] Managing Cart,
  [R04] Checkout Process, [R05] Order Tracking, [R06] Recommended Products

Standard Requirements

- [R07] Register, [R08] Login, [R09] Logout,
  [R10] Change Password, [R11] Edit Profile, [R12] Purchase History

Optional Requirements

- [R13] Add 3D Avatar, [R14] Chat with other buyers, [R15] Mini Game,
  [R16] Browsing History, [R17] CEO message, [R18] About Us

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Template

Level	Critical						Standard						Optional					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		

Template

SrRL: Examples

Template

Level	Critical						Standard						Optional					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		

What a customer expects

Level	Critical						Standard						Optional					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		

A customer explains a whole project in the first day

Level	Critical						Standard						Optional					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1	■	■	■															
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		

SA must get requirements from the customer

Level	Critical						Standard						Optional					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1	■	■	■	■	■	■	■	■	■	■	■	■	■	■				
2	■	■	■	■	■	■	■	■	■	■	■	■	■	■				
3																		
4																		
5																		
6																		
7																		
8																		
9																		

Software Specification Document (Waterfall)

Level	Critical						Standard						Optional					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩				
2	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩				
3	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩				
4																		
5																		
6																		
7																		
8																		
9																		

In the First Release (SCRUM)

Level	Critical						Standard						Optional					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩								
2	🟩	🟩					🟩											
3	🟩	🟩					🟩											
4	🟩	🟩					🟩											
5	🟩	🟩					🟩											
6	🟩	🟩					🟩											
7	🟩	🟩					🟩											
8	🟩	🟩					🟩											
9	🟩	🟩					🟩											

High-Quality Software Project

Level	Critical						Standard						Optional					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩					
2	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩					
3	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩					
4	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩					
5	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩					
6	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩					
7	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩					
8	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩					
9	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩					

Some Delivered Projects ?

Level	Critical						Standard						Optional					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
2	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
3	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
4	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
5	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
6	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
7	■	■	■	■	■		■	■	■				■					
8																		
9																		

Research Showcase ?

Level	Critical						Standard						Optional					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1	█	█	█	█			█	█					█					
2	█	█	█	█			█	█					█					
3	█	█	█	█			█	█					█					
4	█	█	█	█			█	█					█					
5	█	█																
6	█																	
7																		
8																		
9																		

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Many Student Assignments ?

Level	Critical						Standard						Optional					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1	■	■					■						■					
2	■	■					■						■					
3	■	■					■						■					
4	■	■					■						■					
5	■																	
6																		
7																		
8																		
9																		

Expected Student Assignment ?

Level	Critical						Standard						Optional					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1	■	■	■	■	■	■	■	■										
2	■	■	■	■	■	■	■	■										
3	■	■					■	■										
4	■	■					■	■										
5	■	■					■	■										
6	■	■																
7	■	■																
8																		
9																		

Many Senior Projects ?

Level	Critical						Standard						Optional					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1	■	■	■	■	■		■	■					■	■				
2	■	■	■	■			■	■					■	■				
3	■	■	■				■	■					■	■				
4	■	■	■	■			■	■					■	■				
5	■	■																
6	■																	
7																		
8																		
9																		

Expected Senior Projects ?

Level	Critical						Standard						Optional					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1	■	■	■	■	■	■	■	■	■	■			■	■				
2	■	■	■	■	■	■	■	■	■	■			■	■				
3	■	■	■	■			■	■					■	■				
4	■	■	■	■			■	■					■	■				
5	■	■	■	■			■	■					■	■				
6	■	■	■	■			■	■					■	■				
7	■	■	■	■			■	■										
8	■	■	■				■	■										
9	■	■	■				■	■										

In the 1st Release (SCRUM)

Level	Critical						Standard						Optional					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩								
2	🟩	🟩					🟩											
3	🟩	🟩					🟩											
4	🟩	🟩					🟩											
5	🟩	🟩					🟩											
6	🟩	🟩					🟩											
7	🟩	🟩					🟩											
8	🟩	🟩					🟩											
9	🟩	🟩					🟩											

In the 2nd Release (SCRUM)

Level	Critical						Standard						Optional					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩								
2	🟩	🟩	🟩	🟩			🟩	🟩										
3	🟩	🟩	🟩	🟩			🟩	🟩										
4	🟩	🟩	🟩	🟩			🟩	🟩										
5	🟩	🟩	🟩	🟩			🟩	🟩										
6	🟩	🟩	🟩	🟩			🟩	🟩										
7	🟩	🟩	🟩	🟩			🟩	🟩										
8	🟩	🟩	🟩	🟩			🟩	🟩										
9	🟩	🟩	🟩	🟩			🟩	🟩										

In the 3rd Release (SCRUM)

Level	Critical						Standard						Optional					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩								
2	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩								
3	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩								
4	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩								
5	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩								
6	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩								
7	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩								
8	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩								
9	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩								

In the 4th Release (SCRUM)

Level	Critical						Standard						Optional					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		

Expected Student Assignment ?

Level	Required						Mandatory						Nice to Have					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1	■	■	■	■	■	■	■	■										
2	■	■	■	■	■	■	■	■										
3	■	■					■	■										
4	■	■					■	■										
5	■	■					■	■										
6	■	■																
7	■	■																
8																		
9																		

Many Senior Projects ?

Level	Required						Mandatory						Nice to Have					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1	■	■	■	■	■		■	■					■	■				
2	■	■	■	■			■	■					■	■				
3	■	■	■				■	■					■	■				
4	■	■	■	■			■	■					■	■				
5	■	■																
6	■																	
7																		
8																		
9																		

Expected Senior Projects ?

Level	Required						Mandatory						Nice to Have					
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓				
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓				
3	✓	✓	✓	✓			✓	✓					✓	✓				
4	✓	✓	✓	✓			✓	✓					✓	✓				
5	✓	✓	✓	✓			✓	✓					✓	✓				
6	✓	✓	✓	✓			✓	✓					✓	✓				
7	✓	✓	✓	✓			✓	✓										
8	✓	✓	✓	✓			✓	✓										
9	✓	✓	✓	✓			✓	✓										

Summary

Summary

- **A Requirement Item**
  - Can be: a Function, a Feature, a Use Case, a User Story, a Task, a Sub Task, …
  - A Requirement Item contains
    - All Flows = Key Flow(s) + Alternative Flows
- **SrRL: 9 Levels**
  - After Level **3**: Design is Ready for Development
  - After Level **6**: Key Flows are Ready for Demonstration to Stakeholders
  - After Level **7**: The Requirement is Ready for Pilot Users
  - After Level **9**: The Requirement is Ready for Delivery to Customers
- **Priority of Requirement Items**
  - Critical, Standard, Optional
- **Next Steps**
  - Adjust the SrRL concept with Government and Software Industries

[Citation]

Chawuthai, R.,
Software Requirement Readiness Levels (SrRL),
In: The 10th International Conference on Engineering,
Applied Sciences and Technology (ICEAST-2024).

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