

Analysing the SWECOM and DDaT standards for designing a DevOps course content

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Motivation

“Release engineering is not taught; it’s often not even mentioned in courses where it should be mentioned” [Boris Debic](#) (Google Software Engineer)

“One of my biggest hiring concerns is that I need to hire release engineers. It’s like finding unicorns” [Chuck Rossi](#) (former release engineer at Facebook)

“Release engineers are hard to find, and one problem is that they don’t teach the skill set in school” [Kim Moir](#) (release engineer at Mozilla)

Statements taken from “[The Practice and Future of Release Engineering: A Roundtable with Three Release Engineers](#)”

How to solve the problem?

- Include DevOps related content into programmes.
- More problems coming:
 - In which programme?
 - In which stage of the programme?
 - What do you remove from the programme to accommodate this?
 - What is the DevOps related content to be taught?
 - What are the required skills to be obtained at the end of the training?

Proposal

- New training programme
- Organised in 4 levels
- Allow trainees to enter at any level (upon assessment)
- Curricula design: skill based
- Teaching approach:
 - project based
 - student pace
 - personal assistant (attached tutor)

(Some) References

- [SE2004](#) (undergraduate software engineering curriculum guidelines).
- [GswE2009](#) (graduate software engineering curriculum guidelines).
- [GRCSE](#) v1.1, 2015 (Graduate Reference Curriculum for Systems Engineering).
- [CS2013](#) (**Computer Science Curricula 2013**).
- [SE2014](#) (updated version of SE2004).
- [SWEBOK](#) v3, 2014 (**Guide to the Software Engineering Body of Knowledge**).
- [SWECOM](#) v1.0, 2014 (**Description of competencies for software engineers**).
- [GRCSE](#) v1.1, 2015 (Graduate Reference Curriculum for Systems Engineering).
- [Digital, Data and Technology Profession Capability Framework](#), 2017.

Analysis of (some) references

	CS2013	SE2014	SWEBOK	SWECOM	DDaT
Knowledge	x	x	x		
Skill (or learning outcome)	x			x	X
Focus on SE		x	x	x	
Focus on DevOps					X

SWECOM (v1.0)

- Full name: Software engineering **competency** model
- IEEE standard
- First released in 2014
- Content
 - Presents a competency model: the **skills** needed by a person to perform the **activities** assigned to him or her.
- Structure
 - Activity: a self-contained unit of work to be performed
 - Skill: a grouping of logically related activities.
 - Skill area: a grouping of logically related skills (13)
 - Life cycle (5)
 - Crosscutting (8)

SWECOM: skill areas

- Life cycle
 - Software Requirements
 - Software Design
 - Software Construction
 - Software Testing
 - Software Sustainment
- Crosscutting
 - Software Process and Life Cycle
 - Software System Engineering
 - Software Quality
 - Software Security
 - Software Safety
 - Configuration Management
 - Measurement
 - Human-Computer Interaction

SWECOM: skills and activities

Table A11	
Software Requirements Skill Sets	Software Requirements Activities
Software Requirements Elicitation	<ul style="list-style-type: none">• Identifies stakeholders for elicitation of requirements.• Engages stakeholders in elicitation of requirements.• Uses appropriate methods to capture requirements.• Negotiates conflicts among stakeholders during elicitation.
Software Requirements Analysis	<ul style="list-style-type: none">• Uses appropriate domain analysis techniques.• Performs analysis of requirements for feasibility and emergent properties.
Software Requirements Specification	<ul style="list-style-type: none">• Uses appropriate notations for describing requirements.
Software Requirements Verification and Validation	<ul style="list-style-type: none">• Checks requirements for accuracy, lack of ambiguity, completeness, consistency, traceability, and other desired attributes.• Constructs and analyzes prototypes.• Negotiates conflicts among stakeholders during verification.
Software Requirements Process and Product Management	<ul style="list-style-type: none">• Uses appropriate methods for management of requirements, including configuration management.

Example for “Software Requirements” skill area.

SWECOM: levels of competency

Activities are specified at five levels of competency:

- Technician
- Entry Level Practitioner
- Practitioner
- Technical Leader
- Senior Software Engineer

Remark: SWECOM does not prescribe the **knowledge level** or **years of experience** associated with these competency levels

SWECOM: levels of competency example

Table B11					
Software Requirements Skill Sets and Activities by Competency Level					
Skill Sets	Levels				
	Technician	Entry Level	Practitioner	Technical Leader	Senior Software Engineer
Software Requirements Elicitation			1. Identifies important stakeholders. (P/L)		
		1. <u>Assists</u> in engaging different stakeholders to determine needs and requirements. (A)	2. <u>Engages</u> different stakeholders to determine needs and requirements. (P)		
		2. <u>Assists</u> in applying different methods to the project as appropriate to elicit requirements. (A)	3. <u>Applies</u> different methods to the project as appropriate to elicit requirements. (P)		

Example for “Software Requirements” skill area.

SWECOM: what for?

Some examples:

- Practitioners: self-evaluation, self-improvement, and career planning.
- Managers: performance evaluations, and gap analysis.
- Workforce planners: select and hire employees, contract personnel, and contractor organizations.
- **Curriculum designers:** design competency-based education and training curricula

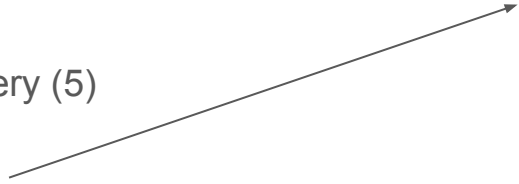
Process to engineer a DevOps programme

- Data collection
 - Skill areas, Skills, and Activities
 - Remark: activities specified according to levels of competency were not considered.
 - At the end each data entry looks like:
 - <skill area, skill, activity>
- Analysis
 - Activity complexity according to [Bloom's taxonomy](#)
 - Activity suitability according to DevOps domain
 - Activity coverage according to early experience on teaching DevOps
- Specification
 - Adapt activity according to DevOps domain
 - Add activity according to early experience on teaching DevOps
 - Skill area, and skill added, if required.
 - Assign programme level (i.e. 1,2,3 or 4) to each activity

DevOps programme: extract

DevOpsEnv Platform	Virtualization	Use virtual machines (VMs) to run controlled experiments.	1
DevOpsEnv Platform	Virtualization	Create VMs to handle environments.	1
DevOpsEnv Platform	Virtualization	Tailor VMs to meet particular environments characteristics.	1
DevOpsEnv Platform	Virtualization	Automate creation of VMs.	1
DevOpsEnv Platform	Virtualization	Automate configuration of VMs.	1
DevOpsEnv Platform	Virtualization	Specify VM configuration to meet particular environment characteristics.	2
DevOpsEnv Platform	Virtualization	Use containers to run controlled experiments.	1
DevOpsEnv Platform	Virtualization	Create containers to handle environments.	1
DevOpsEnv Platform	Virtualization & Networking	Orchestrate VMs.	1
DevOpsEnv Platform	Virtualization & Networking	Orchestrate containers.	2
DevOpsEnv Platform	Virtualization & Networking	Use clusters of containers.	2
DevOpsEnv Platform	Virtualization & Networking	Assist in the creation of clusters of containers.	3
DevOpsEnv Platform	Virtualization & Networking	Design clusters of containers.	4
DevOpsEnv Platform	Virtualization & Networking	Guide in the creation of clusters to achieve scalability of services.	4

DDaT Profession Capability Framework

- UK government
 - Published 23 March 2017
 - Continuously updated: last one 5 August 2019
 - Content
 - Describes the **job roles** and provides details of the **skills** needed to work at each **role level**.
 - Job roles (39)
 - Structure
 - Type of job roles (6)
 - Data (4)
 - IT Operations (11)
 - Product and delivery (5)
 - QAT (3)
 - Technical (9)
 - User centred design (7)
- Technical: data architect
 - Technical: development operations
 - Technical: infrastructure engineer
 - Technical: network architect
 - Technical: security architect
 - Technical: software developer
 - Technical: specialist infrastructure engineer
 - Technical: technical architect
 - Technical: technical specialist architect
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Job role

- High-level description of what the person **does**, and what are his **responsibilities**.
- Example(*): job role description of “Development operations”

1. What a development operations does

Development operations support the development and operation of software through tools, environments and practices.

They are responsible for underpinning good development processes including managing tools and testing environments, central code control, maintaining development standards and writing software that automates systems. This role is commonly referred to as ‘DevOp’.

Job role level

- Group of **skills** and **skill levels** for a particular job role.
 - Capabilities covered by a role level are determined:
 - included skills
 - skill level of each included skill
- Example: job role levels of “Development operations”

2. Development operations role levels

The role levels are:

- [principal DevOps](#)
- [lead DevOps](#)
- [senior DevOps](#)
- [DevOps](#)
- [junior DevOps](#)
- [apprentice DevOps](#)

Skills and Skill levels

- **Skill:** combination of the technical know-how, knowledge and experience needed to do a certain job or task. There are “Essential” and “Desirable” skills.
- **Skill level:** degree of knowledge and experience
 - Awareness < Working < Practitioner < Expert
- Example: Essential skills of an apprentice DevOps

Skill	Description of the skill	Skill level	What the skill level means
Modern standards approach	Uses a modern standards approach throughout automation and testing.	Awareness	Aware of the importance of adopting a modern standards approach.
Programming and build (software engineering)	Uses agreed security standards and specifications to design, create, test and document new or amended software.	Awareness	Understands the process of software development and has a basic knowledge of how services are built.
Service support	Maintains and supports services.	Awareness	Assists in investigation and resolution of infrastructure problems undertaking specific activities under direction of others.

DDaT Profession Capability Framework: what for?

Originally claimed:

- learn about what different roles do in UK government
- understand what skills are needed by professionals in particular jobs
- identify skills that need development to help career progression
- assess skills in preparation for performance reviews
- create effective job adverts
- carry out Human Resources and workforce planning

For us:

- **assess skill coverage** of our DevOps programme
 - Recall: DevOps programme made using the SWECOM.

Process (*) to validate the DevOps programme

- Data collection (done)
 - We fix the “job role” to be equal to “Development operations” (aka DevOp)
 - For each “job role level”, we collect:
 - <skill, skill description, skill level, skill level meaning>
 - At the end each data entry looks like:
 - <“Development operations”, job role level, skill, skill description, skill level, skill level meaning>
- Pre-Processing (to be done)
 - Map each pair (job role level,skill level) to a DevOps programme level number: i.e. 1,2,3,4
 - Example: (“Apprentice DevOps”, “Awareness”) maps to 1
- Analysis (to be done)
 - For each “skill level meaning” check in the DevOps programme
 - if it can be found
 - If found, check whether the programme’s level

Conclusions and next steps

- DevOps programme definition
 - Structured in 4 levels
 - Design based on capabilities (i.e. skills) rather than content
 - Based on SWECOM
- DevOps programme validation (ongoing)
 - Based on DDaT Capability framework
- Learning activity specification (to do)
 - Aimed to ensure the development of the claimed covered skills
 - To be used during programme execution
 - Instructors
 - Quality officers

Q&A