



ESIG Fall Technical Workshop

Making EMT study uptake more manageable

October 23, 2024

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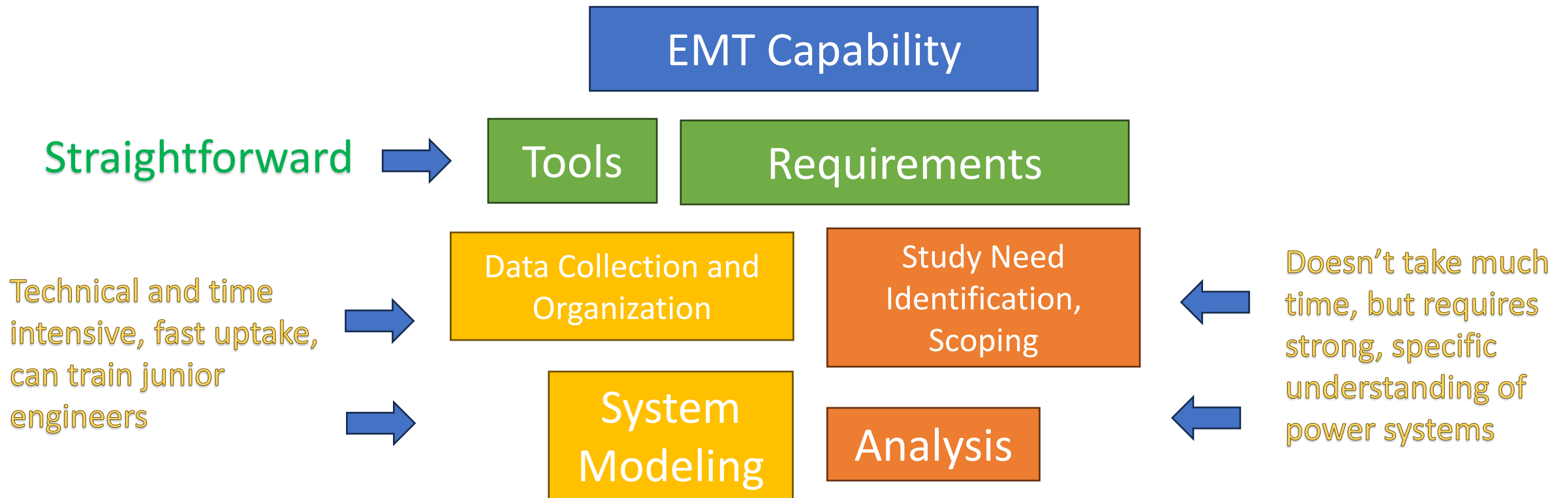
Why EMT?

- NERC recommends, IEEE recommends, other people are doing it, etc, etc... It isn't going away!
- Most important: EMT fills in gaps that are missed by other tools. Put another way: **EMT answers questions that other tools cannot answer!!**

Corollary: If you aren't doing EMT correctly, you aren't adding value (and are adding expense)

Perception: EMT adoption is overwhelming!

Let's break it down into manageable pieces!



The “easiest” parts... you can do this!

- Tools – strong commercial tool options, get advice!
- Requirements – lots of examples available, including templates.



Requirements

- 2023 NERC Guideline has a strong list of EMT modelling requirements
- IEEE 2800-2022 has a detailed list of EMT modelling requirements
- Public, well tested requirement templates available for free:
<https://www.electranix.com/publication/technical-memo-pscad-requirements-v12/>

PSCAD Model Requirements Rev. 12

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This document includes the following attachments:

- Attachment #1: PSCAD Model Test Checklist for Reviewing Model Submissions
- Attachment #2: PSCAD Model Requirements Supplier Checklist

Revision 12 notes (Changes from rev. 11):

Entire document	Editorial changes for clarity
PMR sections A,B	Model Accuracy Requirement: "Real Code" model now required, not recommended
PMR section X	New requirement to compile models using Intel Fortran 15 and Microsoft Visual Studio version 2015 or higher
PMTC (App. A)	Significant updates based on industry feedback in partial alignment with IEEE 2800 std. Now includes more clear requirements for documentation, generator owner attestation of compliance, and additional performance tests.

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The “easier” parts... you can do this!

- Data collection
 - This is the most “trainable” task. Check the models you get using simple testbench systems!
 - Takes time, but can be made into efficient processes
- Data organization
 - This task can start small/simple, but over time calls for a systematic approach.
- Composite system (study) modeling
 - This is a more advanced, but still easily trainable task.
 - Made much easier than in the past with modern tools that translate PDT data into EMT, create equivalents, add study building features etc.
 - **You don't need to build a system wide model!!**

Data Collection and Organization

System Modeling



Note: Junior engineers excel at these tasks!! We see this in training environments

The “easy” part... you can do this!

- EMT Study need identification
 - Requires thought and understanding of regional power system and screening techniques
- Analysis
 - Requires engineering judgement and understanding of power systems concepts visible in EMT

Study Need
Identification,
Scoping

Analysis

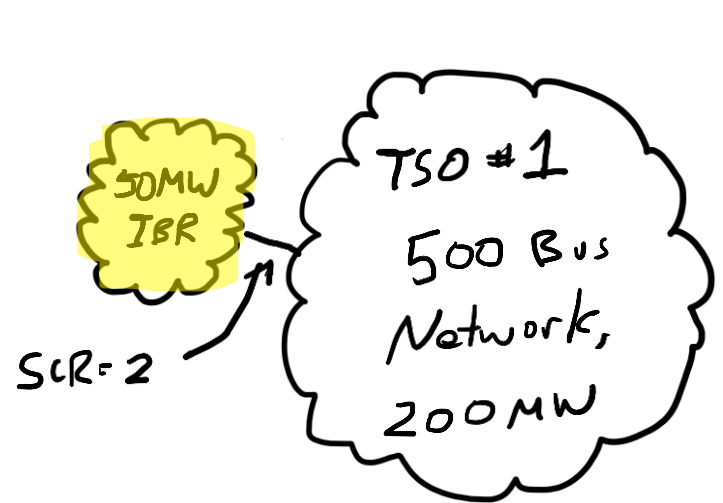


Note: Senior engineers excel at these tasks!! Call up your veterans!

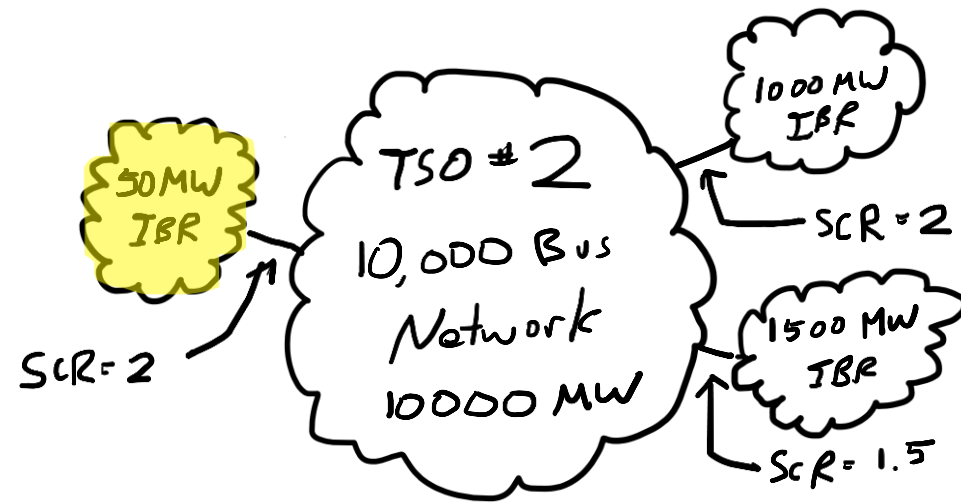
Example

Study Need Identification,
Scoping

Will most studies benefit somehow from EMT? **Yes.**
Should we therefore do EMT study all the time?

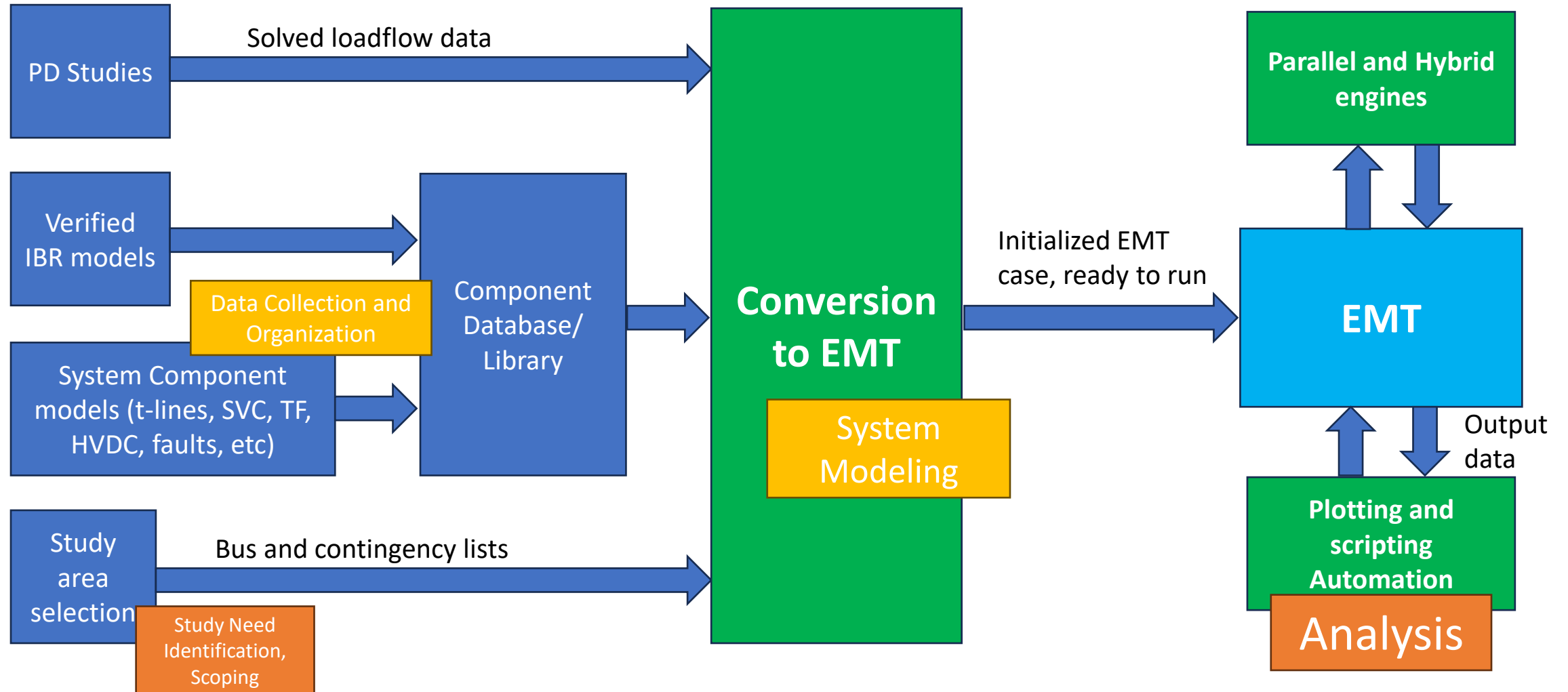


1 engineer available,
2 months to perform study



1 engineer available,
2 months to perform study

Example: Commercial EMT system study process:



This implies that a team is needed (ie. you need to invest in people and make time)

EMT Team (or individual superhero?)



Requirements

Tools

Study Need Identification, Scoping



Data Collection and Organization

Analysis

System Modeling

Where is the industry today?

Small sample from among our industry friends!

TO/ISO requirements at interconnection	ISO or TO								
	1	2	3	4	5	6	7	8	9
EMT model	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
EMT model performance/quality report	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
EMT model performance/quality study	Yes	No	Yes	Yes	No	No	Yes	No	No
EMT/PDT comparison/benchmarking report	Yes	Yes	No	No	Yes	No	No	No	No
EMT/PDT comparison/benchmarking study	Yes	No	No	No	No	No	No	No	No
EMT model validation report	No	No	No	No	No	No	No	No	No
EMT interconnection study always	Yes	Yes	No	Yes	No	No	No	No	No
EMT study based on xSCR and/or manual review	N/A	N/A	Yes	N/A	No	No	Yes	Yes	No
EMT study based on series capacitor proximity	N/A	N/A	N/A	N/A	Yes	Yes	N/A	N/A	No

IEEE 2800.2 is pushing on this requirement...

Industry is getting better at this!

This is hard to do without models!!

Each component of an EMT process is manageable!!

1. Immediately implementing requirements for EMT models, and establishing an intake process should be **highest priority. This is foundational!** Without good models now, you may cripple your future selves!
2. Continue building on this foundation to develop a more robust and scalable EMT study infrastructure that can eventually accommodate:
 - Expert study need identification
 - Data management
 - Fast and accurate study model construction
 - Automated study results processing
 - Expert analysis and action!

Step 1 (intake and checking) is quickly achievable, and the future steps can be done with time. **However, to do this, you will need to invest in people!**

Questions?

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Extra slides

Note on FERC Order Requirements

- FERC Order 2023 is unhelpful in its ambiguity:
 - You do not know yet when a study will be required. The need for study changes as your system changes.
 - You will have a **very difficult and maybe impossible** task to collect good quality EMT models after the interconnection is complete, and it will get harder with time.
 - Asking for EMT models is not so difficult. **Performing a check on them is not much harder, and counts as a study (to gain the backing of Order 2023)**

Let's talk about that "ask", and the statement "performing a check is not much harder"!

Notes on Model Intake

- Request:
 - Model
 - Documentation (including manuals, attestations, validation reports, benchmarking reports, performance test reports)
- Depending on the extent of the request, you may have to:
 - Review model
 - Review documentation, reports, etc
 - Perform independent performance and quality tests
- Extra: benchmarking between software tools if needed
- Extra: integration of models into repositories or databases

Model intake: Quality testing

- Documentation check, including:
 - Attestations (Careful!)
 - Model revision tracking
 - Manuals, test cases
- “Usability tests”
 - Plant specific configuration checks (eg. does the SLD match the model?)
 - Simulation flat runs

Model intake: Performance testing

- Can be a simple system set-up
 - ‘TEST GRID’ component connected to generic PV model
 - Can replace PV model with other IBR plants

<i>Basic performance verification¹⁷</i>			
6a	Initialization Tests: Model meet the success criteria in tests outlined in Table 1		
6b	Balanced Fault Ride-through tests: Model meet the success criteria in tests outlined in Table 2		
6c	Unbalanced Fault Ride-through tests: Model meet the success criteria in tests outlined in Table 3		
6d	Over-Voltage Ride-through Tests: Model meet the success criteria in tests outlined in Table 4		
6e	Voltage Reference Step Change Tests: Model meet the success criteria in tests outlined in Table 5		
6f	Active Power Reference Step Change Tests: Model meet the success criteria in tests outlined in Table 6		
6g	Grid Frequency Response and Ride-Through Tests: Model meet the success criteria in tests outlined in Table 7		
6h	Grid Voltage Phase Angle Change Ride-Through Tests: Model meet the success criteria in tests outlined in Table 9		
6i	POI SCR Change Tests (informational): Model meet the success criteria in tests outlined in Table 10		
<i>Basic protection verification</i>			
7b	Voltage Protection Inclusion Tests: Model meet the success criteria in tests outlined in Table 12		

<http://www.electranix.com/publication/technical-memo-pscad-requirements-v12/>