

# 総合討論

# 議論のタネ

- ▶ 大学と大型プロジェクトの関係
  - ▶ 大学からの参加はどうあるべきか
  - ▶ もちろんいろんなスタイルがあるだろうが
- ▶ 大型プロジェクト時代の人材育成
  - ▶ 大型プロジェクトで学生は育てられるのか
  - ▶ 学位取得以降のキャリアパス
- ▶ 可視赤外装置開発の今後
  - ▶ 大型プロジェクトの進め方
  - ▶ 他のコミュニティとの関係
  - ▶ 企業との関係



# キーワード

- ▶ 装置開発の全体を俯瞰
- ▶ システムエンジニアリング
- ▶ 設計、技術のプロに任せる
- ▶ 科学要求、要求仕様
- ▶ 性能評価、キャリブレーション方法
- ▶ 教育、学生・教員のモチベーション
- ▶ コミュニティーの将来
- ▶ タイムスケールを意識する（学生教育と大プロジェクト）
- ▶ 失敗を恐れない、教訓を前提とした教育と最先端とフィージビリティ優先の大プロジェクト
- ▶ 独自性
- ▶ どのように学位につなげるのか

# TMT観測装置 (2010)



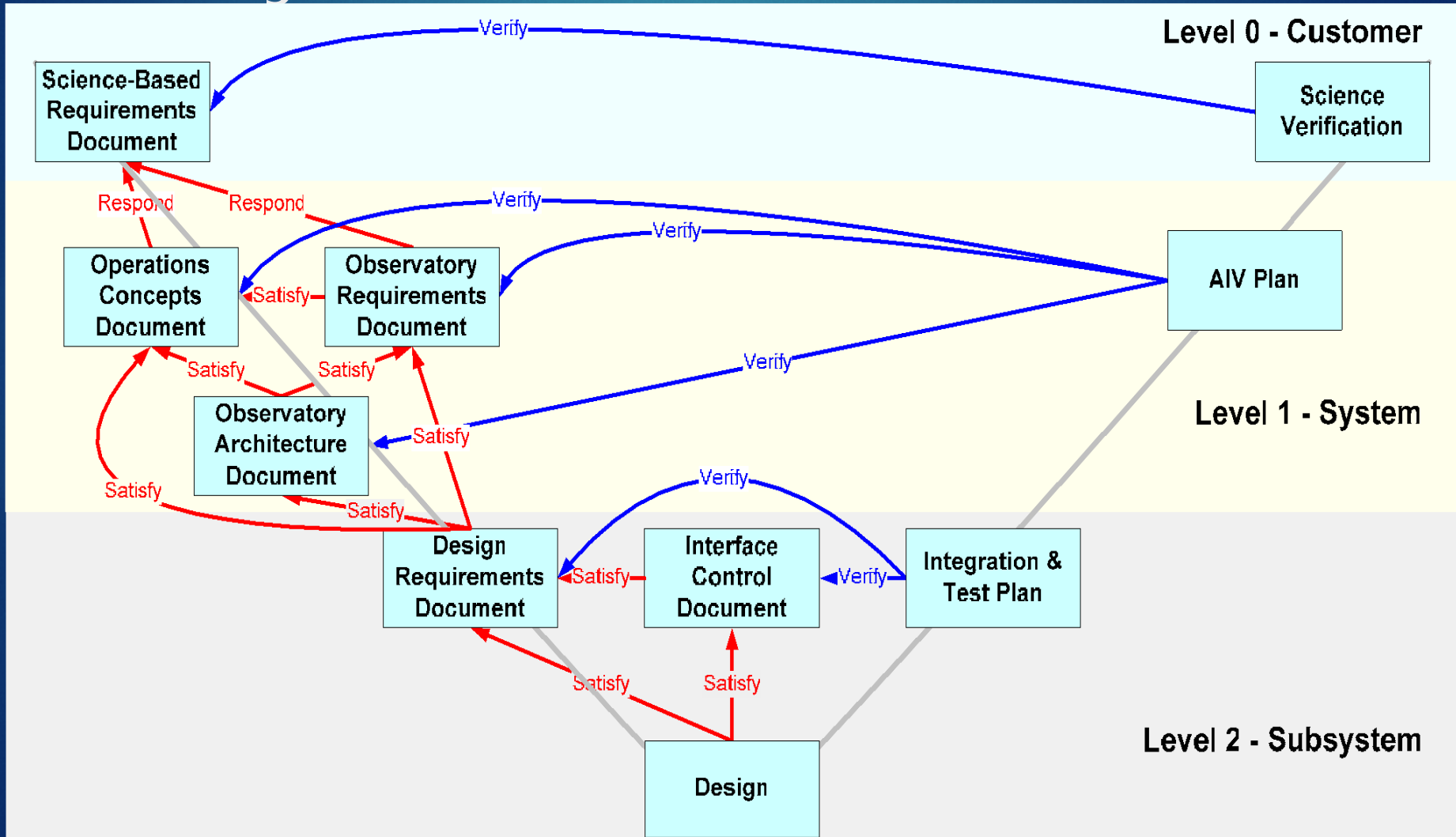
Instrument	$\lambda$ ( $\mu\text{m}$ )		
	0.8 – 2.5 0.6 – 5 (goal)		
	0.31 – 1.0		
	0.95 – 2.45		
	0.8 – 2.5		
	8 – 18 4.5 – 28 (goal)		
	1 – 2.5 1 – 5 (goal)		
	1 – 5		
	0.31 – 1.1		
	0.8 – 5.0	TMT.INS.TEC.10.001.REL02	astrometry (e.g., Galactic Center) • Resolved stellar populations out to 10 Mpc

# TMT観測装置 (2016)

Instrument	Field of view / slit length	Spectral resolution	$\lambda$ ( $\mu\text{m}$ )	Comments
InfraRed Imager and Spectrometer (IRIS)	< 4."4 x 2".25 (IFU) 16".4 x 16".4" (imaging)	4000-8000 5-100 (imaging)	0.8 – 2.4	MCAO with NFIRAOS
Wide-field Optical spectrometer (WFOS)	40.3' squared (FoV) 576" (Total slit length)	1000-8000	0.31-1.1	Seeing-Limited (SL)
InfraRed Multislit Spectrometer (IRMS)	2' field w/ 46 deployable slits	$R = 4660 @ 0.16"$ slit	0.95-2.45	MCAO with NFIRAOS
Multi-IFU imaging spectrometer (IRMOS)	3" IFUs over >5' diameter field	2000-10000	0.8-2.5	MOAO
Mid-IR AO-fed Echelle Spectrometer (MIREs)	3" slit length 10" imaging	5000-100000	8-18 4.5-28(goal)	MIRAO
Planet Formation Instrument (PFI)	1" outer working angle, 0.05" inner working angle	$R \leq 100$	1-2.5 1-5 (goal)	$10^8$ contrast $10^9$ goal
Near-IR AO-fed Echelle Spectrometer (NIREs)	2" slit length	20000-100000	1-5	MCAO with NFIRAOS
High-Resolution Optical Spectrometer (HROS)	5" slit length	50000	0.31-1.0 0.31-1.3(goal)	SL
"Wide"-field AO imager (WIRC)	30" imaging field	5-100	0.8-5.0 0.6-5.0(goal)	MCAO with NFIRAOS



# System Engineering Lifecycle

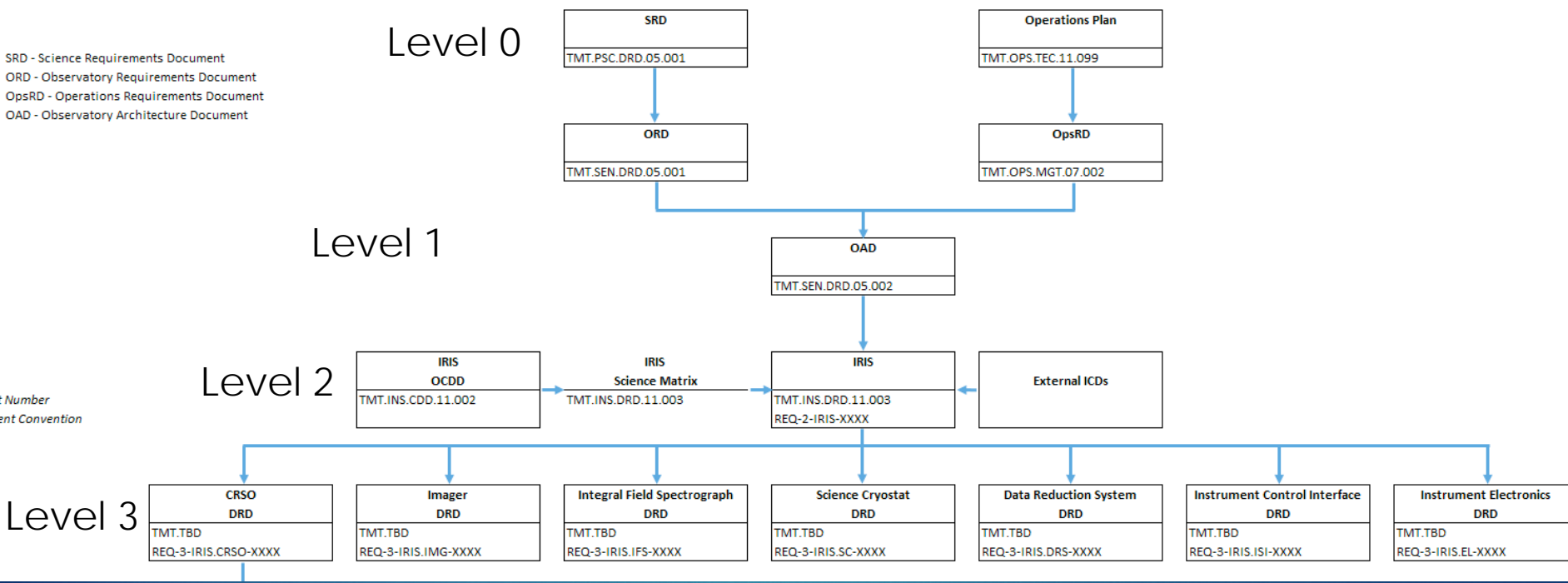


# 装置仕様のブレークダウン



SRD - Science Requirements Document  
 ORD - Observatory Requirements Document  
 OpsRD - Operations Requirements Document  
 OAD - Observatory Architecture Document

File  
 Document Number  
 Document Convention



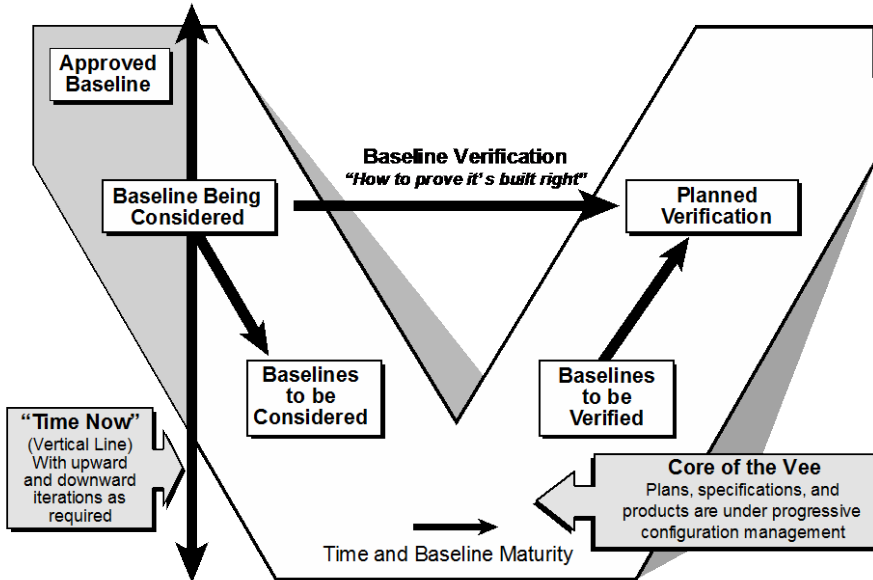
# プロジェクトのフェーズ

INCOSE Systems Engineering Handbook v. 3

ISO/IEC 15288

Concept Stage	Development Stage	Production Stage	Utilization Stage	Retirement Phase
			Support Phase	

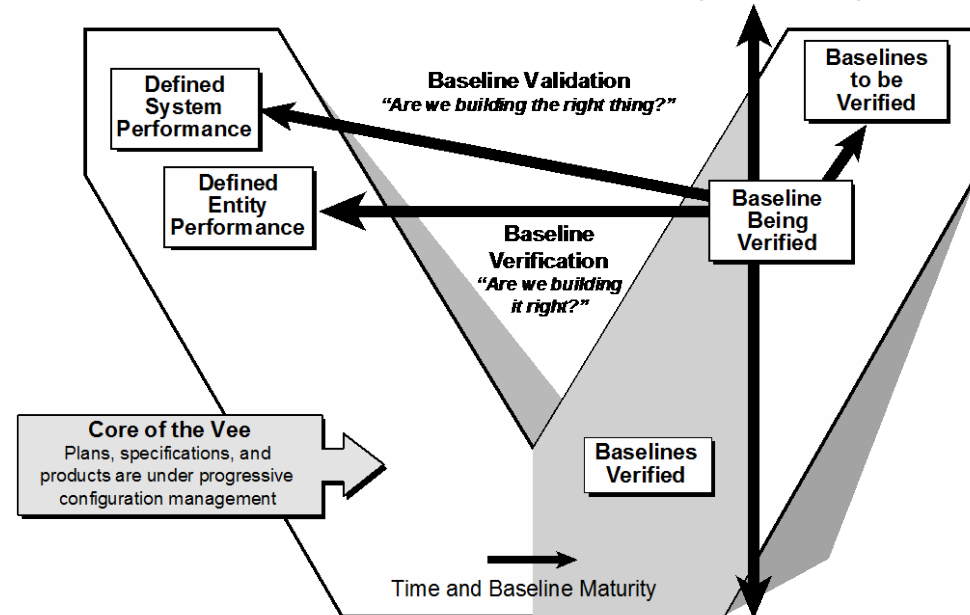
Off-core user discussions and approvals  
(In-process validation)  
*"Are the proposed baselines acceptable?"*



Off-Core opportunity & risk management  
investigations and actions  
*"How are the opportunities and risks of the proposed baselines being resolved?"*

Figure 3-3 Left side of the Vee model<sup>4</sup>

Off-core User Approval  
of Baseline and Baseline Modification  
*"Is the verified performance acceptable?"*



"Off-Core" Verification Problem  
Investigation and Resolution  
*"Is the problem cause understood?"*

Figure 3-4 Right side of the Vee<sup>6</sup>