SPACE
CONSULTANT LTD

BIM INITIATIVE

Small Systems Supply Chain

5D RECIPE *roadmap*

Design Model is divided into Construction model zones

Each zone demands a specific set of fabricated Objects

Fabricated construction products, or Objects, can be constructed using Recipes

Recipes are divided into methods, each representing a unique series of work activities and associated resources

Schedule is extracted and updated with actual start times and durations

data on how many activities are performed on each object

group of objects on which an activity is repeated

Construction *what if scenarios*

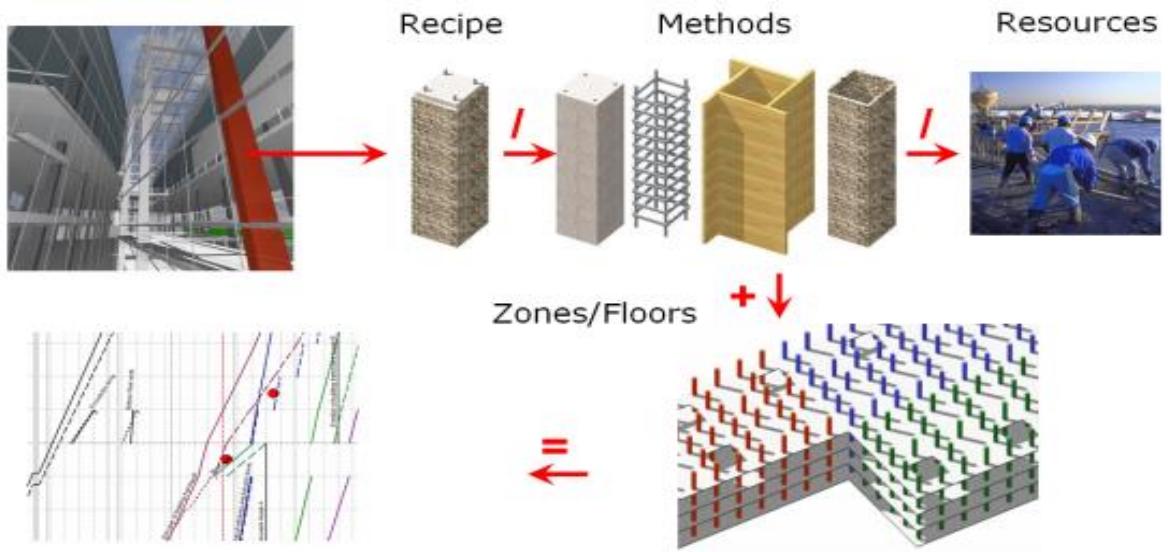
looking at various sequencing options, site logistics, hoisting alternatives

CONSTRUCTION MODEL OBJECT X

OPTIONS	***Estimating Recipe A,…***	***Recipe B,…***	***Recipe C,…***
	Method A : # of Activities : Time A : Cost A	***Method B : # of Activities : Time B : Cost B***	***Method C : # of Activities : Time C : Cost C***
	work activity A1	activity B1	
	associated resource A101	resource B101	
	associated resource A102	resource B102	
	work activity A2	activity B2	
	associated resource A201	resource B201	

Single object COLUMN in a construction model is connected to estimating recipe

1. build rebar for column
2. place formwork
3. pour concrete
   equipment Concrete Mixer, Crane
   materials Cement, Sand
   labor
4. apply finishing

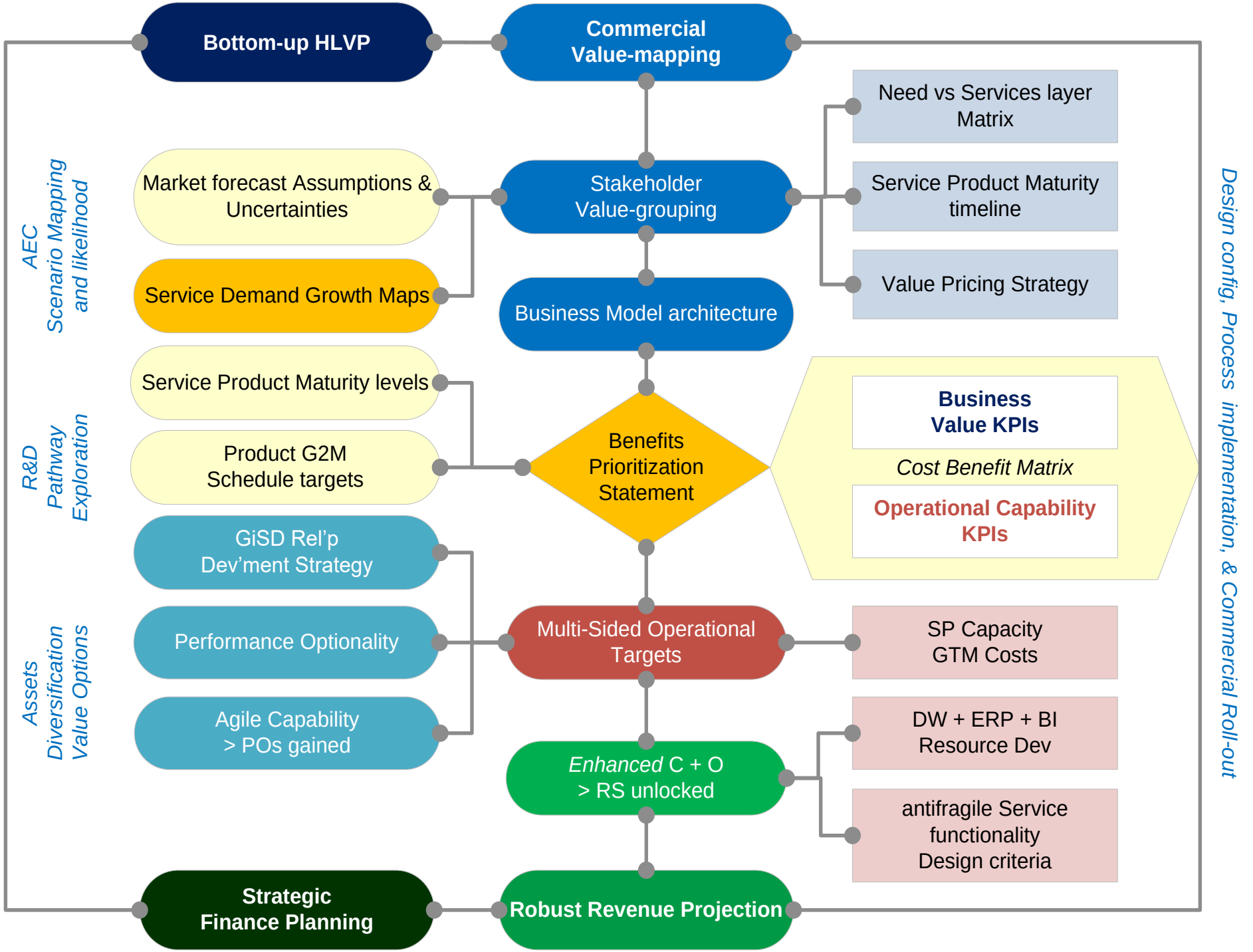


5Des design-phase	design briefing	concept development	schematic development	design development	contract document	CA
documentation stage	20%	40%	60%	80%	100%	
steel estimate		conceptual	parametric	detailed	prescribed	
5Dex level of detail	**100**	**200**	**300**	**400**	**500**	**600**
baseline	line-worked zones	3D-placeholder	generic geometry	specific geometry	5Dex geometry	
definition	2D	fake-3D	out-of-the-box contents	custom content	catalogue models by 5Des	
description	model element may be graphically represented in the model with an indication of the cost per square foot of floor area inferred from elements that are modeled (floors), coupled with other information (square foot cost tables)	model element is graphically represented as a generic system, object or assembly with approximate quantities, size, shape, location and orientation * > **50% CD** : **LOD 250** will be designated for design milestones	model element is developed to further accuracy in terms of quantity, size, shape, location and orientation At **LOD 350**, the elements are sufficiently-developed with installation detail to facilitate **Costing** & **cross-trade Coordination** — *for clash detection & avoidance, layout-guides, etc*	model element developed with detailing, fabrication, assembly and installation info for *FD*, or *Shop Drawings*	model element is a field-verified representation, updated to reflect any differences between as-designed condition and the as-built condition, accurate in terms of size, shape, location, quantity and orientation	*as-built* columns and braced–frames + applicable fireproofing
model	*n/a*	generic components	confirmed 3D-object		functional models by 5Dex	
description	*n/a*	3D placeholder	geometry with clear spaces		structural elements with exact sizes	
components	imported CAD-files **+ primary quantities**	**3D-boxes** clear spaces with maximum sizes	3D-Object Geometry **+ connections**	3D-Object Geometry **+ dimensions**	3D-Object Geometry **+ callouts**	actual size **& placement**
5Des coordination	none	rudimentary space-planning	space planning with low-level coordination	**DFF** ops coordination **DFA** shop drawings	**DFM**-steel design standardization *with automated pricing*	installation

*LOD **250** and LOD **350** will be used to overcome issues around the subsequent services construction design by contractor
these custom levels will be used to track design-progress and work as a QA check

LOD **290** = preliminary construction defined
LOD **292** = checked for functional requirements
LOD **294** = checked for fire requirements
LOD **296** = checked for smoke requirements
LOD **298** = checked for acoustic requirements
LOD **300** = final construction defined

The expanded definitions in the LOD Specification use the following interpretations of these terms
Specific – quantity, size, shape, location, and orientation of element as designed can be measured directly from model without referring to non-modeled information such as notes or dimension call-outs.
Actual **–** model element includes all the qualities of a specific element and is representative of the manufacturer-specific model to be installed or the construction intent of assembly.


Bottom-up HLVP
Commercial Value-mapping
Need vs Services layer Matrix
Service Product Maturity timeline
Value Pricing Strategy
Stakeholder Value-grouping
Business Model architecture
Market forecast Assumptions & Uncertainties
Service Demand Growth Maps
AEC Scenario Mapping and likelihood
Service Product Maturity levels
Product G2M Schedule targets
R&D Pathway Exploration
Benefits Prioritization Statement
Business Value KPIs
Cost Benefit Matrix
Operational Capability KPIs
GiSD Rel'p Dev'ment Strategy
Performance Optionality
Agile Capability > POs gained
Assets Diversification Value Options
Multi-Sided Operational Targets
SP Capacity GTM Costs
Enhanced C + O > RS unlocked
DW + ERP + BI Resource Dev
antifragile Service functionality Design criteria
Strategic Finance Planning
Robust Revenue Projection
Design config, Process implementation, & Commercial Roll-out

5Dex
open sandbox

innovation for all

CONTRACT	CORE-SUPPL	ACTIVITIES	PROTOCOLS	CONTROLS
Delivery Strategy by Project Type, Goals & Design-specs *historical + current*	Task ownership **Execution Process** & Lines of communication	5Dex-BIM **supported Tasks** + 5Dex requirements / **applicable Protocols**	**MIS –appropriation** task schedules & alerts update procedures	model quality **synchronization procedures**
ADDRESS **Functional Gaps in Design Engg / MEP** professional / trade responsibilities	AUGMENT **Mgmt Discontinuities in Project execution** from prelim. Design to Construction Ops	TARGET **Operational Islands in Value delivery** ineffective coordination or poor communication	**2D to 3D CAD Model** perception exchange navigational capabilities **3D to 4D CAD Model** construction layering	**LOD 450** immersive design prototype with **1:1 scale + depth** perception

5Des
solutions

delivering lifetimes

DFFabrication	**DFA**ssembly	**DFI**nventory	**DFM**anufacturing	**DFR**etrofitting	**DFC**arbon
MAXIMUM **EOR CONTROL**	MINIMUM **DELIVERY LIFECYCLE**	MINIMUM **LIABILITY OPTION**	MINIMUM **COST DESIGN**	specialty **COMPONENT** DESIGN	
detailing structural steel connections to FPC-specs	m^3–design appropriation for fastest erection cycles at job-site	employing alternate knock-down assembly sourcing strategies in Black Swan events	cost-reduction by scale economies using product standardization	repairing existing steel & concrete (sub) structures	

steelmate
job execution class

set by designer

consequence class	service category	production category	
CC3 – HIGH - HALLS **CC2 – MED - OFFICE** CC1 – LOW - STORAGE	**SC1 – BUILDINGS** SC2 – ROADS, BRIDGES	PC1 – NON WELDED PC1 – WELDED <S355 **PC2 – WELDED >S355**	**EXC2** ***for structural steel office buildings***

total quality mgmt flow enablers	5Des LEAD MGMT	JobMart DD-SCM	JobMart PIECE-MARKING	*CIS/2-EDI* BARCODE	*jobsite* COLOR BANDS
	ENGAGEMENT CATEGORY SLA TYPE & PRIORITY LEVEL	PLANNED JOB ACTIVITY + ACTIVE DELAYS SCH. FORECASTS	JOB-CLASSIFICATION STEEL PART ID SHIPPING RECORDS	SHIPPING CLASS & LOCATION STATUS CHECK 5DES+ MART+ SHOP+ SITE	ZONING COLOR CODES
configuration sequence	**FIND REQUIREMENTS** from applicable standards	show conformity to specs **inspection protocols** **QA PRODUCT TESTING**	production control implementation **SYSTEM ARCHITECTURE**	PART **ID SYSTEM** classification & designation	
factory production control	workforce qualifications **welding, crane ops**	steel design **BS EN 1090**	welding quality **1048**		documented processes **ISO 9001**
performance guarantee	declaration of **conformity** **DESIGN-SPEC TESTING**	FPC linked to **execution classes**			design-specs-check **warranty**

5 D e x *engagement matrix by*

SERVICE **fields**

&

PRACTICE **expectations**

steel chain **service fields**

transparency **lenses**

technology adoption

inclusion **process**

engagement **policy**

player *& technology* competency stage 1 2 3	**deliverables** *by process*	**requirements** *per policy*
conceptual	scoping	disciplinary
relationship definitions between different concept models	*granular* assessment levels	classification systems
		K P I s
	organizational scales	competencies by field
software	hardware	network
applications *& deliverables*	equipment	network soln
data	mobility	security & access control

resources	workflows	products + services	leadership mgmt
physical infrastructure	knowledge	service specs	communicative attributes
	skills	product specs	innovation + renewal
	esperience	service product differentiation	leadership attributes
knowledge infrastructure	roles	project delivery approach	organizational attributes
	dynamics	research & development	managerial attributes
			strategic attributes

mandates	protocols	guides
contract type	benchmark or metric	best practice
	manual	case studies
programme or schedule	activity plan	model frameworks
		model guidelines
	procedure workflow & rules	learning modules
rules of engagement		integrated reporting
	standards & specs	strategy programmes
		classification

practice MATURITY INDEX		service fields by scale		competency set		capability stages
capability **maturity**	e / bp levels					
information management	e / bp levels					
quality management	e / bp levels					
performance management	e / bp levels					
service level **regulation**	e / bp levels					

practice **Guide**	POLICY	PROCESS	TECHNOLOGY
	bim ontology + visual knowledge models = framework deliverables + extensions		
data interchange	D|F	D|F + F|C	D|F|C
practice **fields**	clusters	interactions	overlaps
BIM **integration**	GDL-education	PMT -modeling	TVD -collaboration
	logical programming	lifecycle phases	data-flows
operational **lenses**	practice fields	integration stages	kpi dashboards

lean site **management culture**	technologies, services & products	software, hardware & network changes	training modules & capability upgrades	**new service product offering**
	business process	gaps & changes		**design coordination**
	people	practice role & critical activity gaps		**clash detection visualizations**
exchange **roadmap**		readiness		
		certifications		
		data quality control		
	consolidate for lifecycle	estimate	*how, where, and what changes work best*	
		cost data		
		scheduling		

model LOD	200	300	400
Steel Chain Impact	DFA-Class CONSTRUCTABILITY DRIVES ESTIMATION & ZONING LOC	SCHEDULE ANALYSIS LINE OF BALANCE DRIVES PROCUREMENT	HIGH-RISK LONG-LEAD DRIVES SITE MGMT
augmented FRAMEWORK	RULES of Engagement	commercialization of DIGITAL ASSETS	DESIGN of Value Expectations
design-CAD file *conversion*	**2D > 3D** LOD 200 *.dxf* to LOD 300 *.dstv*	**3D > 4D** LOD 300 *.dxf* to LOD 400 *.dstv*	**4D > 5D** LOD 400 *.dxf* to LOD 500 *.dstv*
steel frame **Estimating Recipe**	**Steel-member** Construction Method	Activity OpEx & Duration by Zone & Floor	Sequence of Activity Clusters & handover-Time
Work Activities	Zone Planning by Floor	Material, Man-power & Machinery	Work Sequence Scheduling
Resource Tracking	Design-Build Optimization	Inventory & Resource Booking Forecast	I/O time-series Mapping
IPD design criteria	Fabrication Build Quality	Work Activities Cost Impact	Lead time & Schedule Impact
IPD Critical Path	Costing Complex Items	Tracking long-Lead Items	Caring for high-Risk Items

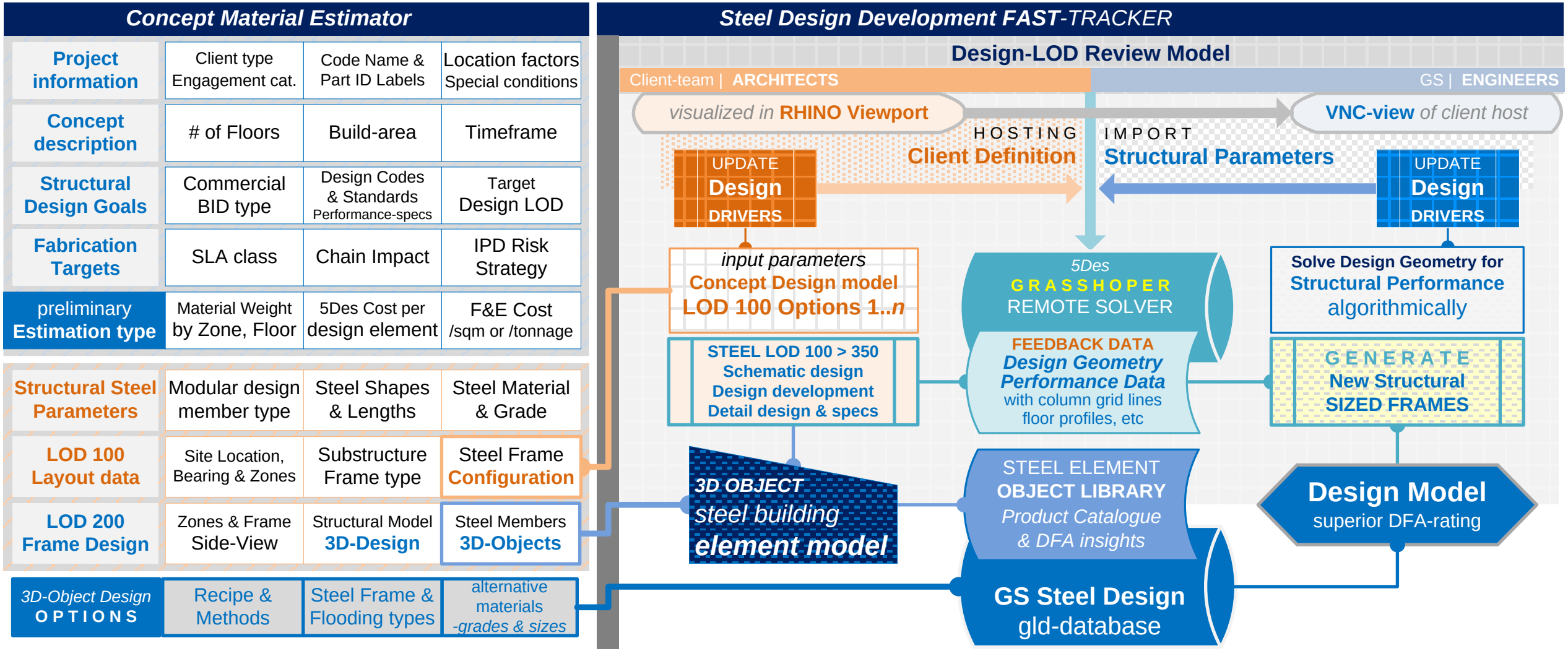
***logical model connection with* LISTING ENGINE**

Properties to instruct Listing Engine to calculate Part ID as complex structure with sub-components in Calculation Materials

Areas for ***Inventory Calculations*** to be defined using Zones / Floors

Individual Part IDs in ***LOD 400 drawings*** to be extracted for fabrication

Nathan Miller's Slingshot! plugin for Grasshopper / MySQL interoperability


Concept Material Estimator
Project information
Client type
Engagement cat.
Code Name &
Part ID Labels
Location factors
Special conditions
Concept description
# of Floors
Build-area
Timeframe
Structural Design Goals
Commercial
BID type
Design Codes
& Standards
Performance-specs
Target
Design LOD
Fabrication Targets
SLA class
Chain Impact
IPD Risk
Strategy
preliminary
Estimation type
Material Weight
by Zone, Floor
5Des Cost per
design element
F&E Cost
/sqm or /tonnage
Structural Steel Parameters
Modular design
member type
Steel Shapes
& Lengths
Steel Material
& Grade
LOD 100
Layout data
Site Location,
Bearing & Zones
Substructure
Frame type
Steel Frame
Configuration
LOD 200
Frame Design
Zones & Frame
Side-View
Structural Model
3D-Design
Steel Members
3D-Objects
3D-Object Design
OPTIONS
Recipe &
Methods
Steel Frame &
Flooding types
alternative
materials
-grades & sizes
Steel Design Development FAST-TRACKER
Design-LOD Review Model
Client-team | ARCHITECTS
GS | ENGINEERS
visualized in RHINO Viewport
VNC-view of client host
HOSTING
Client Definition
IMPORT
Structural Parameters
UPDATE
Design
DRIVERS
UPDATE
Design
DRIVERS
input parameters
Concept Design model
LOD 100 Options 1..n
5Des
GRASSHOPER
REMOTE SOLVER
Solve Design Geometry for
Structural Performance
algorithmically
STEEL LOD 100 > 350
Schematic design
Design development
Detail design & specs
FEEDBACK DATA
Design Geometry
Performance Data
with column grid lines
floor profiles, etc
GENERATE
New Structural
SIZED FRAMES
3D OBJECT
steel building
element model
STEEL ELEMENT
OBJECT LIBRARY
Product Catalogue
& DFA insights
Design Model
superior DFA-rating
GS Steel Design
gld-database

5Des DFA-QA algorithm

LOD 400-3D building model

GS AEC Steel Design gld-database

GS Logistics + bar codes gsl-database

JOBSITE ZONING
3D-model split into **construction Zones**
- bearing & sequence
- plan & elevation
- steel member DFA features

HOISTING SEQUENCE
No. of lifts by Zone **–OpEx rate**
- crane-type ***+(LRFD)***
- height, range of lift
- availability & booking forecast

PAYLOAD DELIVERY PLANNING
BY CONSTRUCTION ZONES

3M-Construction Coordination *per **Zone-X***

Steel-member installation-Recipes & associated Activities

Recipe Methods Cost & Duration	Work Activities Materials, Man-power, & Machinery (3M)	Steel-installation Activity-Grouping

Recipes are logically programmed for optimal risk-cost

Activity : 3M Work Sequencing Options	Site Logistics Hoisting Options	Activity Schedule *Start : End durations*

Costed Activity-schedules by Resource-utilization Rates

Activity : 3M Work Costing Options	Site Logistics JIT Options	Activity Cost *prerequisite liquidity*

3M : JIT *RE*ALIGNMENT

DECISION SUPPORT TOOLS

work sequence (+re) prioritization	erection order re-configuration	cost-center *re*-assignment

IPD STATUS *REPORTING*

DESIGN-FAB PROJECT MODELING

5D SIM-MODEL REVIEW detect potential field-errors

STEEL FRAME INSTALLATION TRACKING

FIELD-CHECK PLAN verify design specs are met

5Des KPIs *on-target?*

QA INSPECTION PLAN
- DFA GUIDE LAYOUT & **ERECTION PLAN**
- APPROPRIATED **CRANE PLAN**
- crew + machinery **MOBILIZATION PLAN**

BAR-CODE TRACKING
- **OUTBOUND** HOLDING STORAGE
- EQUIPMENT **G-METER sensors**
- SITE-SUPERVISOR **REPORTING**

real-time ***plan** vs **field*** **VERIFICATION**

3M-COST PERFORMANCE *REPORTING*

PERFORMANCE KPIs
Work Progress
Schedule adva
Cost Savings
DFA impact

RISK ASSESSMENTS
IPD schedule
Cost control
Worker Safety

COST KPIs
Resource Utilization
nspection rates
Daily Output
nedule-Savings

5Des Steel Fabrication
updated using Jobmart data

PROJECT PROGRESS SUMMARY

project **profile**								
5Des PART CODE	GA Drawing	Description & QA-quals	History	**Jobmart ID**	Material Quantity	Man-Hours by activity	Activity progress %	Part-fab completion %

g|steel Job-Mart
synchronized with Facility IT infrastructure

STEEL TRACKER

weighting	Material recieved	Welding preparation	Full Weld	Blasting & Coating	Final Inspection	Site Delivery

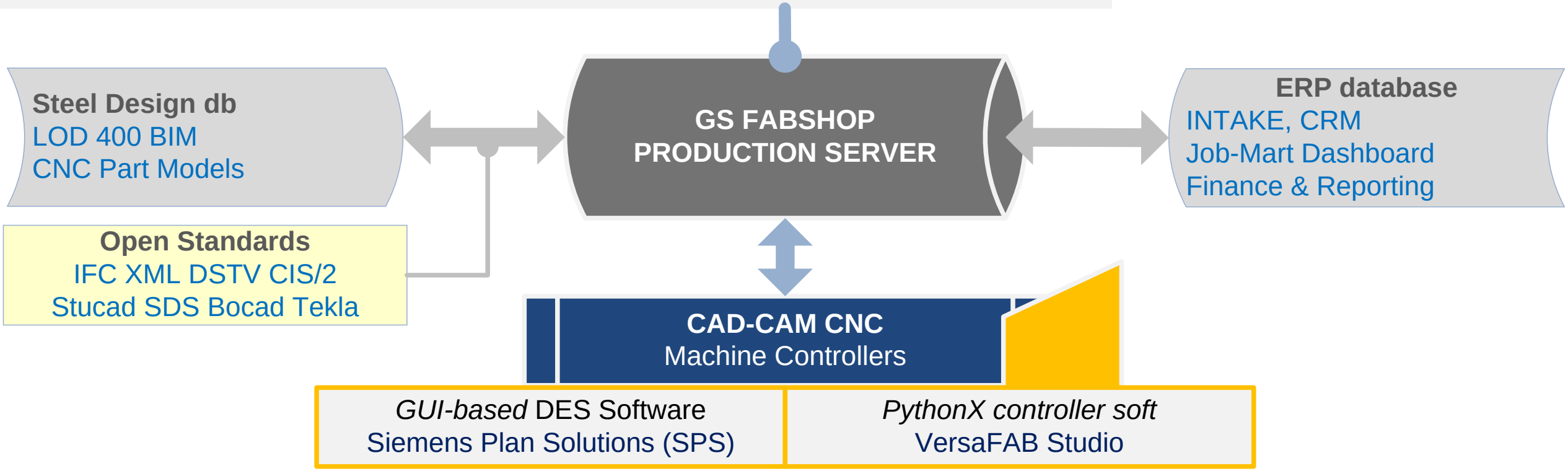
5Des Steel Fabrication
LOD-tracker

PROJECT DESIGN SPECS

project **name**					project **category**	project **description**	project **schedule**	project **estimate**		
UniFormat level								phase SD DD CD	L O D 300 400 500	
1	2	3	4	5	project **architect**	project **engineer**	general **contractor**			*M E A*
A					**substructure**					
A	**10**				**foundations**					
A	**10**	**10**			**standard foundations**					
A	**10**	**10**	**1**		**footings & pile-caps**					
A	**10**	**10**	**1**	**10**	**strip footings**					
A	**10**	**10**	**1**	**20**	**spread footings**					
A	**10**	**10**	**1**	**30**	**pile caps**					

front-end MIS *apps*

OFFER	Engineering	BOM	Cost Estimation
ORDER	Definition	Plan & Phases	Milestones
DESIGN & DETAILING	Structural Design	CAD-integration	BOM
STOCK & PURCHASE	Purchase	Stock	Cost-control
PRODUCTION	Process automation	Planning	Progress
TRANSPORT	Stockyard	Planning Trucks	Delivery Notes
ERECTION	Simulation	Planning	Progress




M I S
back-end systems
CAE
Structural analysis
& Detailed Design
Scia Engineer
CAD
Detailing Model
team-collaboration
Tekla, SDS, Strucad
CIM / MRP
Materials Mgmt, Fab-Ops,
& Logistics
Scia Steel Manager
ERP
CRM + Finance
front-end MIS
DIGITAL ASSET ARCHITECTURE
internal
COBie Object Library
5Des collaboration platform
FAST-TRACKING 200 to 500
OODBMS + BIM File-hosting
link to sub-CAD-CAM-CNC
ENGINEERING DESIGN & DETAILING
BID instruments & tools
LOD300 FD + BOM + Schedule
gsl-db + SDS/2
Detailing + DFA-analysis for
Modular Construction
NavisWorks + SDS/2
In-Model Review
Trade-verification & approval
QUANTITY ESTIMATION + SCHEDULING SYSTEM
Quantity extraction & Detailed
Cost Estimation
Resource Booking
for Lean Scheduling
Site-planning for Materials,
Teams, Equipment & Loc
back-end ERP
FACTORY PRODUCTION / FABRICATION CONTROL SYSTEM
Steel Inventory Management
Piece-Marking & Bar-Code CIS/2
Scia Steel Manager
JOB-MART Performance
& color-Band Status Monitoring
gsl-db + SDS/2 + CIS/2
DFA +
Quality Assurance Reporting
NavisWorks + SDS/2
FIELD COORDINATION
BIM-onsite Data-MS
for Field verification, Guide Layout,
& Installation Tracking
gsl-db + SDS/2
Real-time Resource Mgmt
& JIT equipment delivery
gsl-db
Truck & Crane Logistics,
& Erection Sequencing
NavisWorks
ENTERPRISE MOBILITY
Call-out Fusion algorithms to 3D
BIM Models & Objects
OpenBIM SDK for
IFC-based middleware apps
BIMX apps
for Android-based devices

GiSD | integrated project delivery

3D *i*-BIM = 4D Programme data + 5D Cost elements

5Des Server–managed interfaces for open-processes = **4D MIS** data integration enabled by IFC / IFD + **5D** Commercial data managed in ERP

BIM Linkage with CNC-fabrication process control systems

p m b c
FRAMEWORK

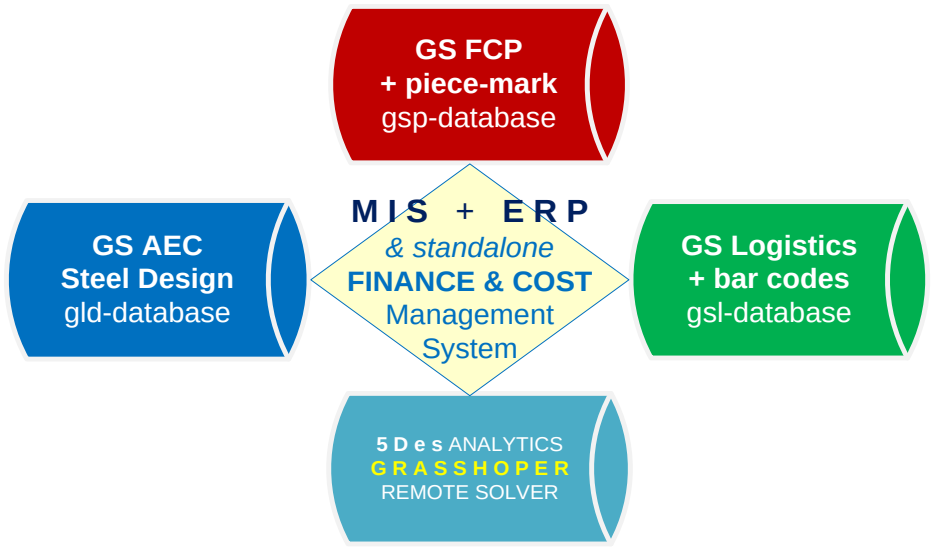
GS Steel BIM-model **Components in Object Library**
Data Management Systems **with remote-access authorization**
link to
GS CAD-CAM FPC
systems

5D Fab-ops & JIT delivery **estimation system**	Inventory Cost + Schedule & Quality Management **reporting system**	HR management & **financial systems**

application layer
5Des 3D-model design coordination
g|steel FCP + logistics-reporting
enterprise mobility

database layer
5Dex intelligent 2D-CAD
Word docs, excel spreadsheets
pdf docs, 2D drawings

foundation layer
5Des LOD Specs
Design Agreement clauses
Steel-BIM Input Schedule
BIM Project Plan + Notes



project model *interaction*-**control by user type**

phase *functions & activities*		owner	architect	engineers	gen. contractor	subcontractors
preparation		appraisal				
		design briefing / criteria				
design		concept design				
		design development				
		technical design				
pre-fabrication		production information				
		tender documentation				
		tender action				
		specialist design				
fabrication						
erection		mobilization				
		practical completion				
close-out		inspection				

every phase has a functional set of delegated activities (**TBD**)
functions and activities may be added or deleted as the project develops
functions may have multiple leads for different aspects
– 2D drawing generation / design decision support
– interactions may vary based on capabilities onboard / capacity-at-hand
in an IPD-project setting, service-fields and their functions
may use or support any other function

conceptual design

- 1.0 Visualization
- 1.1 Design Decision Support
- 1.2 Rendering
- 1.3 2D drawing-generation
- 2.0 Space Planning

primary author / lead

provide input to lead

extract model-output for own work-activity input

5Des-BIM **INPUT SCHEDULE**		draft BIM-Plan	draft BIM-Plan Stage 1
increasing Level of Detail (LoD) as BIM-Plan matures over stages detailed-Process Monitoring begins at Stage 1 technical-Coordination beings at Stage 2		BIM design assessment Design Agreements Links to associated Documents	Principals engagement appropriated Project-docs, Standards & Templates
approve BIM-Plan	assign Resource-Plan	find Technical-Needs	find Training-Needs
Agreement on Extent of BIM-intervention & applications	Identify Resources required for implementation	Identify Project ICT-requirements Hardware + Software	Identify knowledge – skill – gaps and mapped training schedules
BIM-Plan Stage 2	monitor Compliance	Critical Assessment	Model operating
Finalize BIM-Plan	Structure monitoring BIM-Plan status on Agendas	alignment of Asset -criticality Assessment with 5Des Policy docs	Construction, Operation & Maintenance

L O D m a t r i x

5Dex LOD specs	5Des design standards	g|steel fabrication standards	conformance benefits matrix	bim assessments & agreements	bim standards & protocols	handover model server-to-FM timeline-status

steelmate turnkey fabrication project lifecycle

PER SQ.FEET
10 lbs of Structural Steel in Design
@ **Tk. 1000** for Fabrication & Erection

F P C Certificate — 90 days Lead time for Procurement + Design Detailing

Welding Certificate — 60 days Lead time for off-Site Fab + pre-Assembly

Declaration of Performance — 120 days Lead time for on-Site Erection + Coating & Finishing

% of Total kWh

Industrial Product Structural Recipe

		Transit Route & Schedule

GS *Port-City* Warehouse

direct imports hot-rolled Beams galvanized Steel	local Steel Mills & Suppliers *Plate & Tubing*	secondary Suppliers *Nuts and Bolts*

Transfer to Inventory

Inbound Inspection	Pre-treatment Cleansing	Cut to Length Plate Girders

Transfer to Job-Staging

Print + Tag Job-ID # & PO Schedule	Stamp CE Markings	Print + Tag Erecton Sequence #

Transfer to Job-Mart

Allocate by Priority	Assign by Process	Update All Schedules

pass-through PythonX — %

Import Part File .dxf or .dstv in VersaFAB	Load Steel Plates for hole-drilling & Edge-processing	Validate Data & Approve Sequence Update Job-Mart

Transfer to Fitting — 5%

Punch / Bore Bolt holes	Bevel Joints	Flat bearing Surfaces	Camber Beams & Girders

Transfer to Welding — 10%

Weld Moment Connections	Weld Base Plates	Weld Job-IDs Part-Marking

Transfer to H-beam assembler

Tack-weld Beam 3x Plate girders	Flip H-beam & Weld undersides	Beam-flange Straightening

Transfer to Finishing

Run Sand-blaster + Grind Surface	Apply protective Paint or Coating	Bake coated-Steel Product

Transfer to QA Inspection

Assign for Rework	Approve Shipping	Update All Schedules

Transfer to Outbound Storage

	Store fabricated Steel members by Areas of the Frame	Load & Transport Payload to Site by Erection Sequence

SEQUENCE ONE — **TWO** — **THREE**

FOUNDATION DEV
COLUMN-SETTING
Grout Leveling Plate on Foundation prior Column installation

Mobilize to Set up S1-Cranes on-Site

Unload Members onto wood Blocking

Attach ***CHOKERS*** , or Wire Ropes at Center for lifting using Hoisting device

Foreman uses LOD 500 Drawings to Orchestrate Crew & Erection Order

SHAKEOUT
Sort Steel pieces for efficient erection of **Columns with Splice, then Girders & Beams**

HOISTING
MULTIPLE LIFT RIGGING
Lift, Position, and temporarily Fasten Steel members using **Bolts / Welds**

PRIMARY BOLTING
Fasten Connections @ **2 bolts/connection** with pins to align holes using **Spud Wrench**

Install CDZ
perimeter safety cabling around vacant Flooring System

Place **Metal decking** Weld **Sidelap Connx** & **Shear Studs** with **Stud-Welding Gun**

Place **Bracing** for temp. Lateral Stability as directed by Foreman and Demobilize Cranes

Erection Crew of Seven
1x foreman
2x ironworkers hooking steel
2x ironworkers connecting steel
1x crane operator
1x oiler

BAR-CODE READER
Q A CHECK
A V COMM

PLUMBING UP
Check vertical Alignment using **Theodolite** at building perimeter

FINAL BOLT-UP
Connect all Steel Components and Tighten Tension-Controlled **Bolts (F1852)** using **Torque Wrench**

Install Masonry Shafts and Secure steel frame to vertical masonry shafts, then Remove temporary bracing

Install welded Wire Fabric Pump and Level Concrete for Composite Floor Slab

Concrete extruder
Concrete pump
Trowel screed
Tarpaulins
for applying Concrete

Apply spray-on **fireproofing material** portland cement or gypsum-based product

Blastcrete pump
for Spray-Fireproofing

Set Finishing Concrete w/ Curing Compound

steelmate

CHAIN DIVE | **Labor Productivity – Capital R&D & Profitability spectrum**

INBOUND PROCESSING

intra-regional Trade **competitiveness**	**complementary** Production caps	
rolled-Steel profiles (Plates, UKB+Cs) from **T-1 suppliers** from China / India	Steel and Scrap mini-mills	
	Steel Importer / wholesaler / commodity traders	
Parts & Compos (Nuts, Bolts, etc) from **T-2 suppliers** from China / India	OEM / SMME cottage industries	
Production Consumables (Gas, Paint, etc)	Distributors	

PRODUCTION DESIGN

ms-Network **Technology Strategy** for multiplying *R&D* Enterprise Value

packaging standards & expectations	unified-comms to lead harmonization of Common Standards	digital modeling using LOD-defined BIM-Object Library	practice-embedded organic knowledge transfer & training
precision engineering capabilities	Demand-dev by achieving productivity Benchmarks	BIM-powered precision-fab workflow for first-pass QA	unlock new Rev-streams in O&M repair services
incentivizing productivity & creativity	sanitize & commercialize rolling Digital Assets	AA crowd-sourcing GIS-content & SketchUp Designs	enter new markets in Interior Design, Ship-Building –IM

***fab*–Detailing** caps	1092-*compliant* **FPC** & **Traceability**	
EXC levels dictate specific product, material & quality	inbound Procurement & Inventory control	Piece-Marking & remote tracking
***job*–Status Visibility**	1048-*compliant* **WMS**	ISO:9002 **QAMS**
FPC system framework	WPS & WQMS protocols	QC inspection & Packaging

MARKET SEGMENTATION

commodities for large-scale Industry	specialties for limited-volm orders
Retail to OEM	Wholesale to SMME cottage industries
Repair facilities	

QCD caps for export competitiveness

Regional Distributor aftermarkets	Regional Sourcing Agents
	EU+EFTA Sourcing Agents

V-CHAIN FINDINGS	Rising Cost of Raw Materials & Lead-times	local export-quality supplier base vital to competitiveness	supply assembly from focused production facilities	% of domestic Value-added Cost is diminishing		Labor cost advantage is inapt for competitiveness	domestic market alone is insufficient to support efforts	Buyers desire R&D-caps to lower Resource Costs
CRITICAL STEP	Inbound Customs lengthy glitches & Port Handling	harmonized standards & Testing caps	uncompetitive transshipment via regional ports	planning towards near self-supporting network of factories	CC / CV		Channel development	Product & Process standardization
ISSUE	misclassification at multiple-tier duties & tariff levels	costly adoption of new standards is deterring progress	lingering infra'ture issues throughout region	underdeveloped qualified T2 & T3 Backward Linkages	*10% Outage-waste bottom-line impact vs <1% targets*	low Labor productivity (CTG / hr)	extremely limited interactions and linkages shared	Buyer Sensitivity warrants protection from Embassies
COST IMPACT	administrative speed-money is 30%of transactions	significant impact on overhead cash outlays	countering material Lead times has nom. Cost Impact	Opting for local stnds compromises scale economies	Cost of Waste is superimposed on Production Cost	critical input costs makes first-pass QA imperative	nat'l focus erodes competitiveness and deters growth	inbound FDI & x-industry production patterns

Profitability in steel-material & component fabrication is increasingly dependant on commercializing design expertise & broadening qualified supplier netchain to off-load low-production margins

RAISING RESILIENCE BY **LOWERING CONSUMPTION**

design complexity ∝ *imported BOM* —∝ *order volume* ∝ *global sourcing frequency*

LOWERING COSTS BY SCALE ECONOMIES BY TAKING **AN INTEGRATED REGIONAL MARKET DEVELOPMENT APPROACH**

VIRTUOUS CIRCLE evolves from skill-build-up using BIM technology to expand enterprise value profitability

linkage industries ∝ *share of domestic value creation* ∝ *cost control and profitability* ∝ *investor happiness*

Inclusive growth ∝ *skills adequacy and productivity* ∝ *integrated project success* ∝ *client satisfaction*

DFManufacturing	DFAssembly	DFFabrication	DFRetrofitting	DFCarbon
MIN **WEIGHT DESIGN** using less steel in design + fabrication	MIN **COST DESIGN** lean site-scheduling fastest erection cycles	MAX **DESIGN CONTROL** detailing structural steel connections	**STEEL RETROFITTING** repairing existing steel & concrete (sub) structures	material harvester app recycled % in steel d-build Scrap-mill TQM checking & cleaning material reuse
accurate estimating & Mill-ordering	Rethinking Design & construction Recipes	**DFEnergy** *alternate sourcing strategy* –assembly–washing–painting–QC–		Down-Re-Up -Cycle Scrap for lower-equivalent-or value-added IP

WINNING STRAT	balance Trade by ASEAN-purchase agreements	localize production, reduce ForeEx risk by single market	local sourcing for on-Demand JIT supplier support	Develop distributed production Caps for limited products	distributed model that rationalizes production	Communication Transparency & high Standards	Develop & Expand dom. market & Diversify EXC-caps	advocate pathways to New markets via trade agreements
WORK AROUND	B2B e-Commerce trade facilitation by XML	AICO + MRA schema-certified harmonization	extend industrial base to gain local production scale	increase private sector participation exchange programs	develop industrial obligations via complementation	KPI-Reporting of Six-Sigma + CSR	BIM + IPD = **CPO** lockstep optionality	T1 Greenfield Ops EXC & DoP + AoC Cert. systems

Quality Management Control flowchart

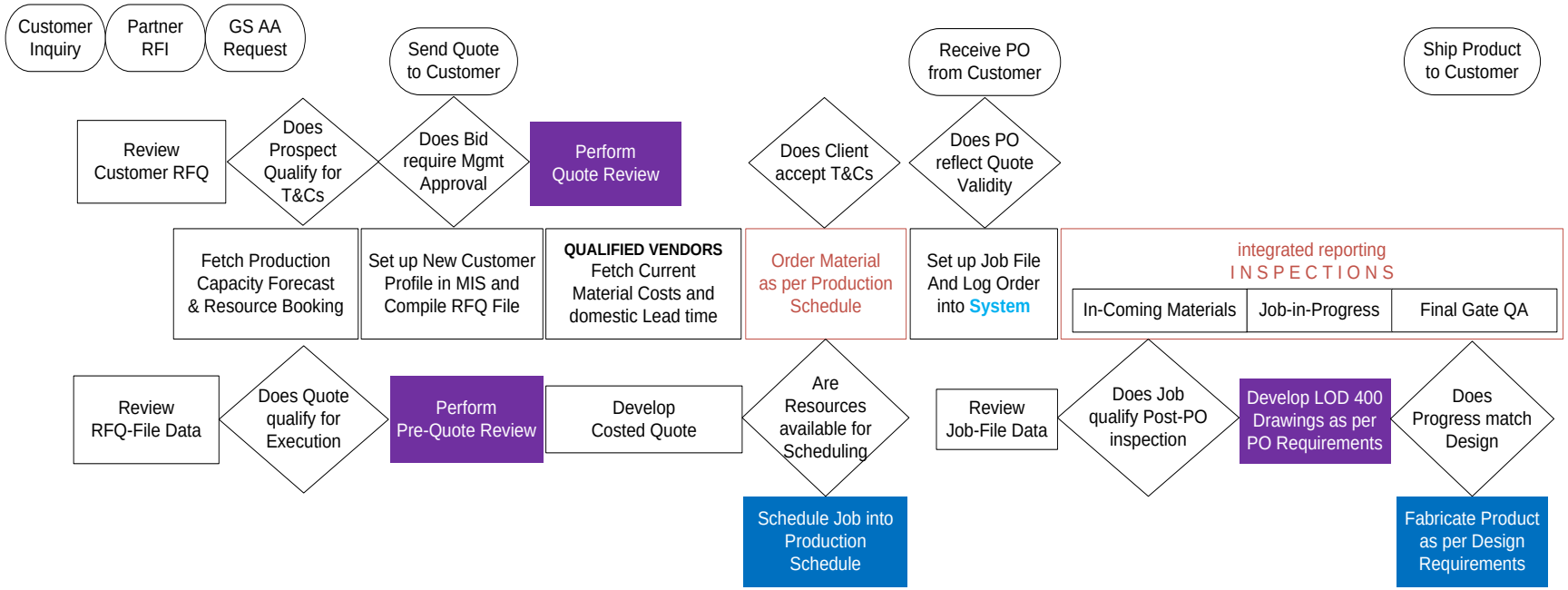
LEGAL RECORD | SHOP ORDER | DESIGN MEMO

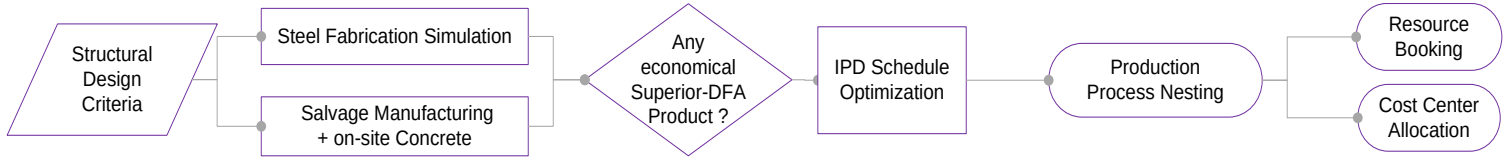
QUALITY ASSURANCE — Salesforce M I S

DESIGN FOR FABRICATION — 5D Design Engineering

DESIGN FOR ASSEMBLY — Shop-Ops E R P

STEEL CHAIN DELIVERY PLANNING — IP Recipe Selection Factors





Procurement Strategy Alignment

Design Alignment
Material Sourcing
Logistics Schedule
Project Delivery Risk
SMME Development
GS Sustainability

Steel Fabrication Process Db

Steel I / O (kg) + Slag %
Process Cost (Tk)
Energy Rating (kWh)
Production Rating (kWh/kg)

Salvage Manufacturing Db

Salvage I / O (kg) + Waste
Process Cost (Tk)
Energy Rating (kWh)
Production Rating (kWh/kg)
Auxiliary Production Activities

IP Recipe Production Db

IP Weight
Material Suppliers
Material Cost
Material Transfer Options
Workmanship Criteria
Process Requirements
Delivery time
Production Cost
Quality Check Rating
IP Waste factor
IP LCV

Delivery Chain Impact

Steel Inventory
Resource Booking
Project Schedule
Project Cost
Production Waste
Internal Delivery
Transportation

Fabrication & erection

10 lbs/sq.ft @ Tk1K
1 Part / 80 sq.ft
200-250 Parts / floor
30 Parts / truck load
40 Hoisted / day

Logistics Db

Inter-Site Options
Route Utilization
Transport Load (kg)
Load Capacity (kg/trip)
Route Distance (km)
Fuel Rating (km/L)
Trip Time (min)
Trips per Ton (#)
Fuel Consumption (L)

DFA SITE PARAMETERS

ROAD ACCESS TYPE
Concrete Road
Bituminous Road
Hydraulically bound Road

SITE GROUNDWORKS
Ground Improvements
Earthworks Embankments
Earthworks Cuttings
Shallow Foundations
Deep Foundations

UTILITIES ACCESS GRADE
Electricity Grade
Utilities Access
Utilities Reinstatement in Roads
Concrete Substructures
Concrete Structures

ENVIRONMENTAL IMPACT
Industrial Buildings
Residential Buildings
Hospitals

SPACE
CONSULTANT LTD

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