

Figure 1

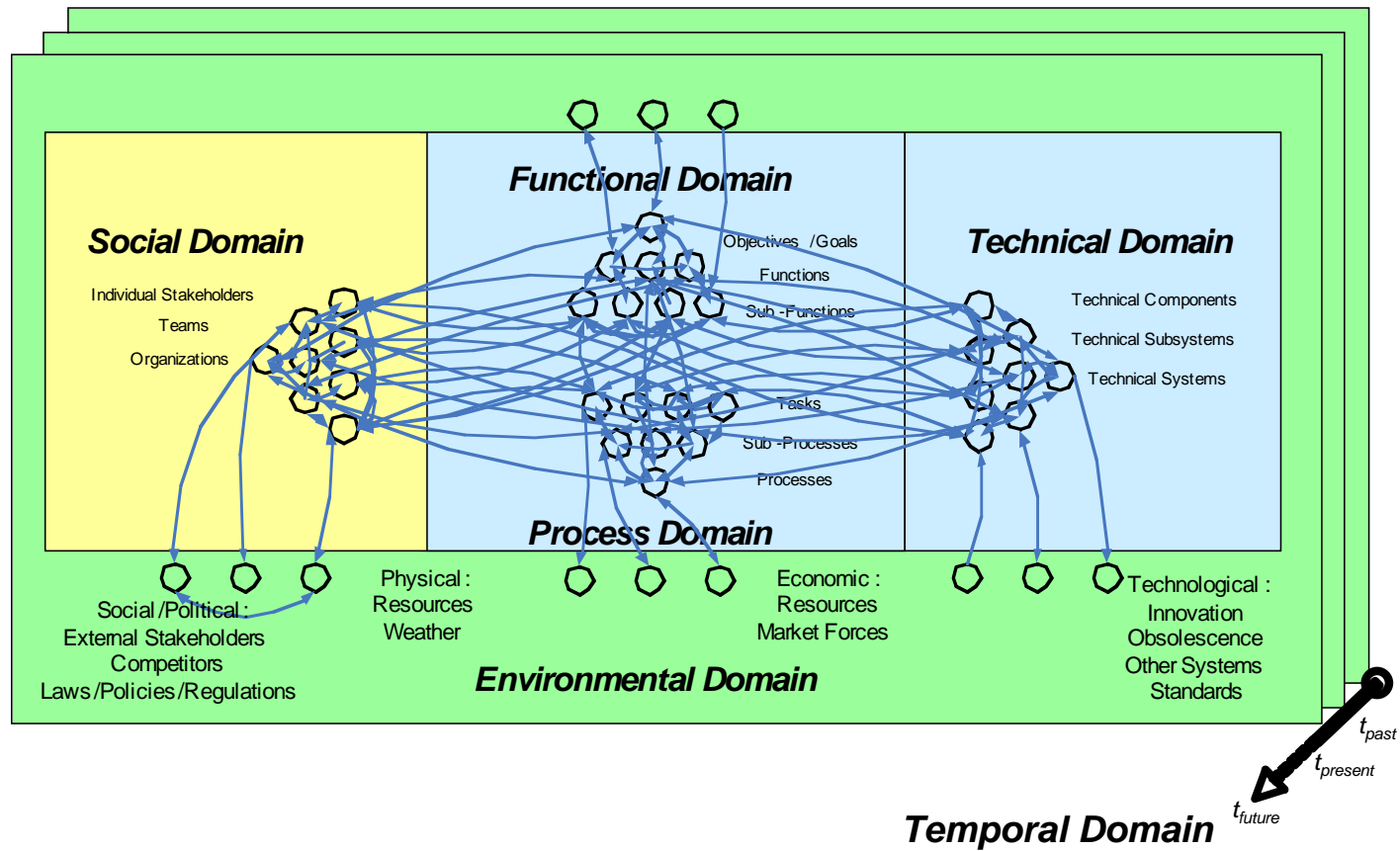


Figure 2

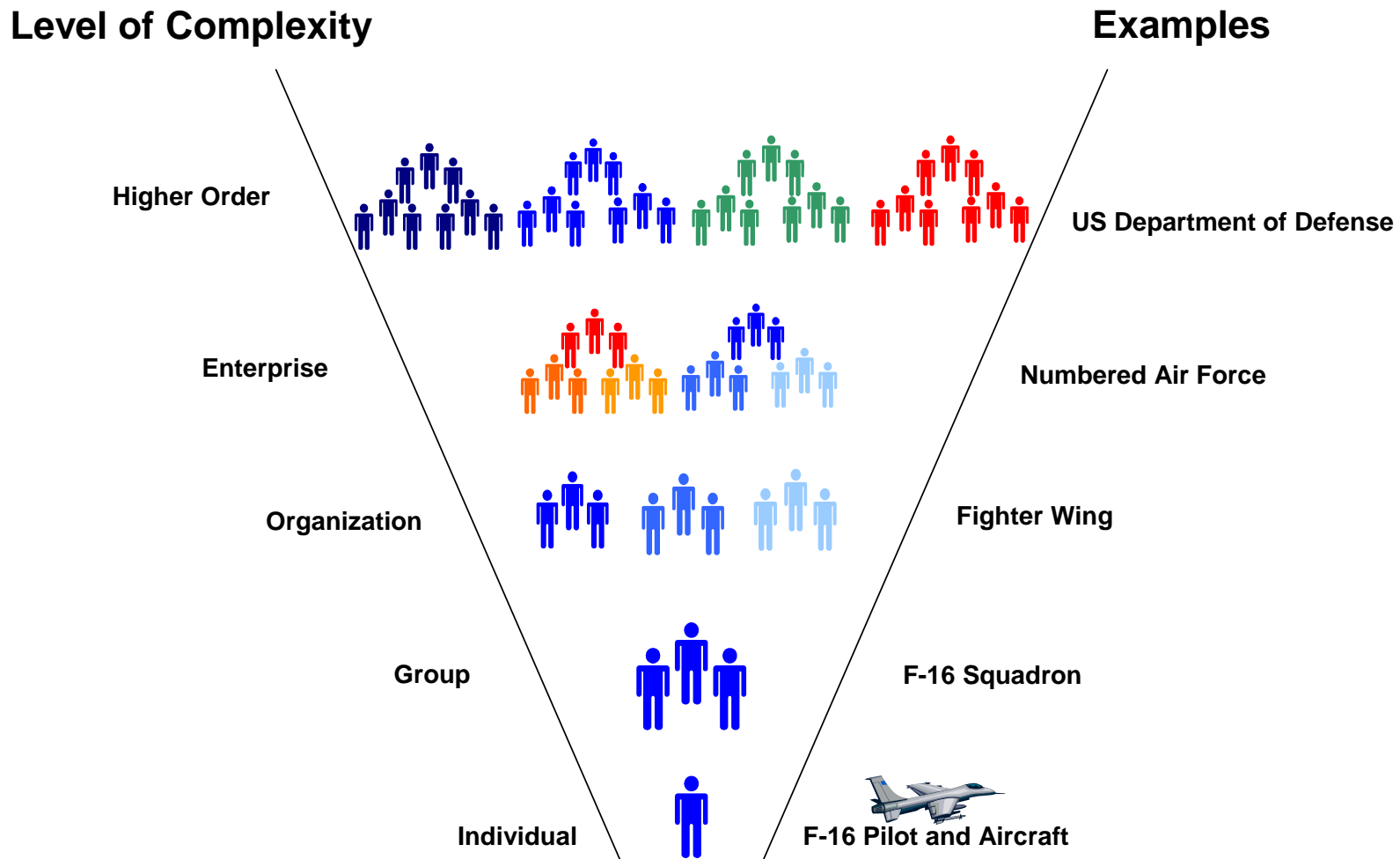


Figure 3

	Environmental Domain	Social Domain	Functional Domain	Technical Domain	Process Domain	
	System Drivers	Stakeholders	Objectives	Functions	Objects	Activities
System Drivers	System Drivers X System Drivers	Stakeholders X System Drivers	Objectives X System Drivers	Functions X System Drivers	Objects X System Drivers	Activities X System Drivers
Stakeholders	System Drivers X Stakeholders	Stakeholders X Stakeholders	Objectives X Stakeholders	Functions X Stakeholders	Objects X Stakeholders	Activities X Stakeholders
Objectives	System Drivers X Objectives	Stakeholders X Objectives	Objectives X Objectives	Functions X Objectives	Objects X Objectives	Activities X Objectives
Functions	System Drivers X Functions	Stakeholders X Functions	Objectives X Functions	Functions X Functions	Objects X Functions	Activities X Functions
Objects	System Drivers X Objects	Stakeholders X Objects	Objectives X Objects	Functions X Objects	Objects X Objects	Activities X Objects
Activities	System Drivers X Activities	Stakeholders X Activities	Objectives X Activities	Functions X Activities	Objects X Activities	Activities X Activities

Figure 4

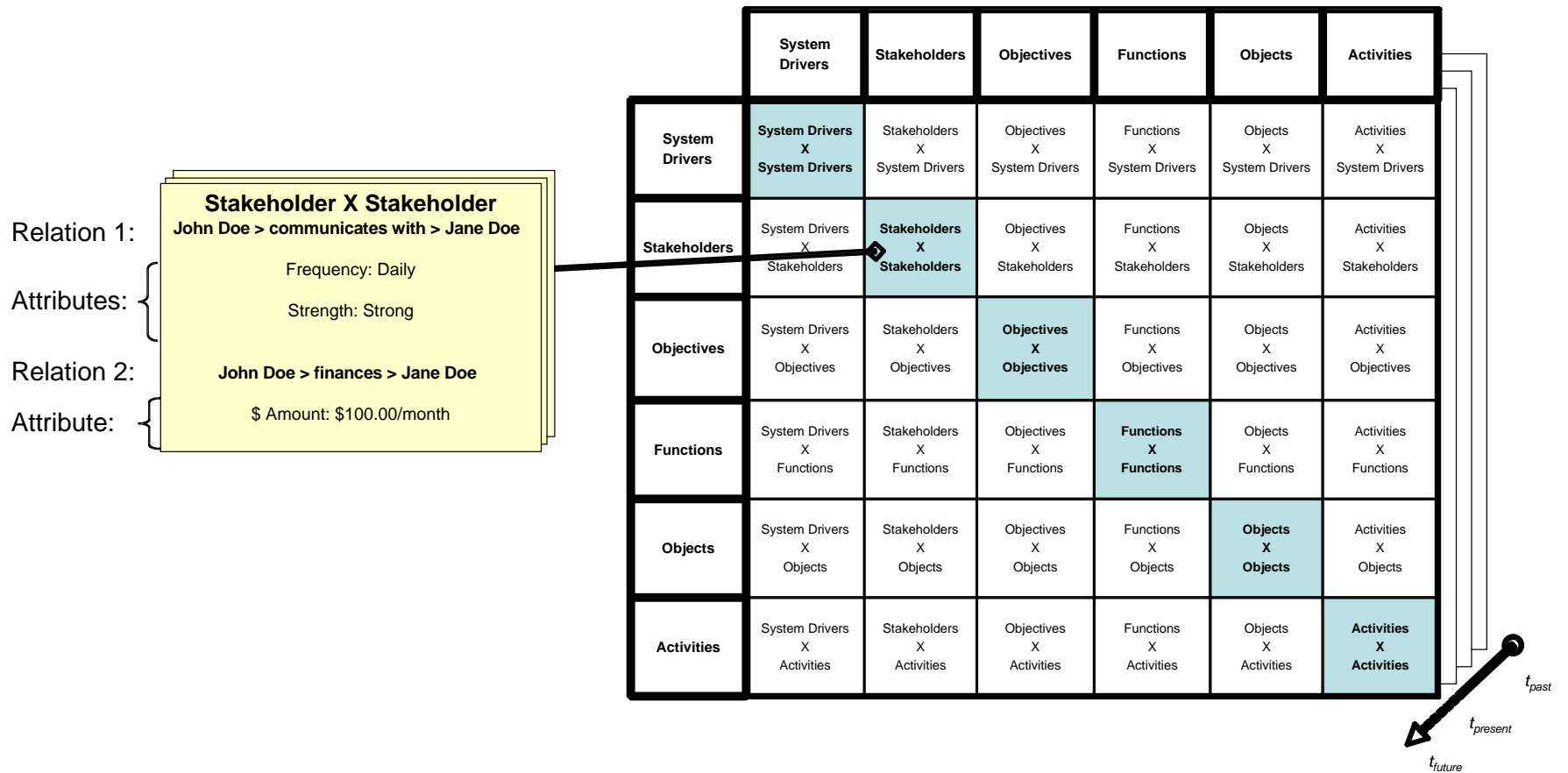


Figure 5

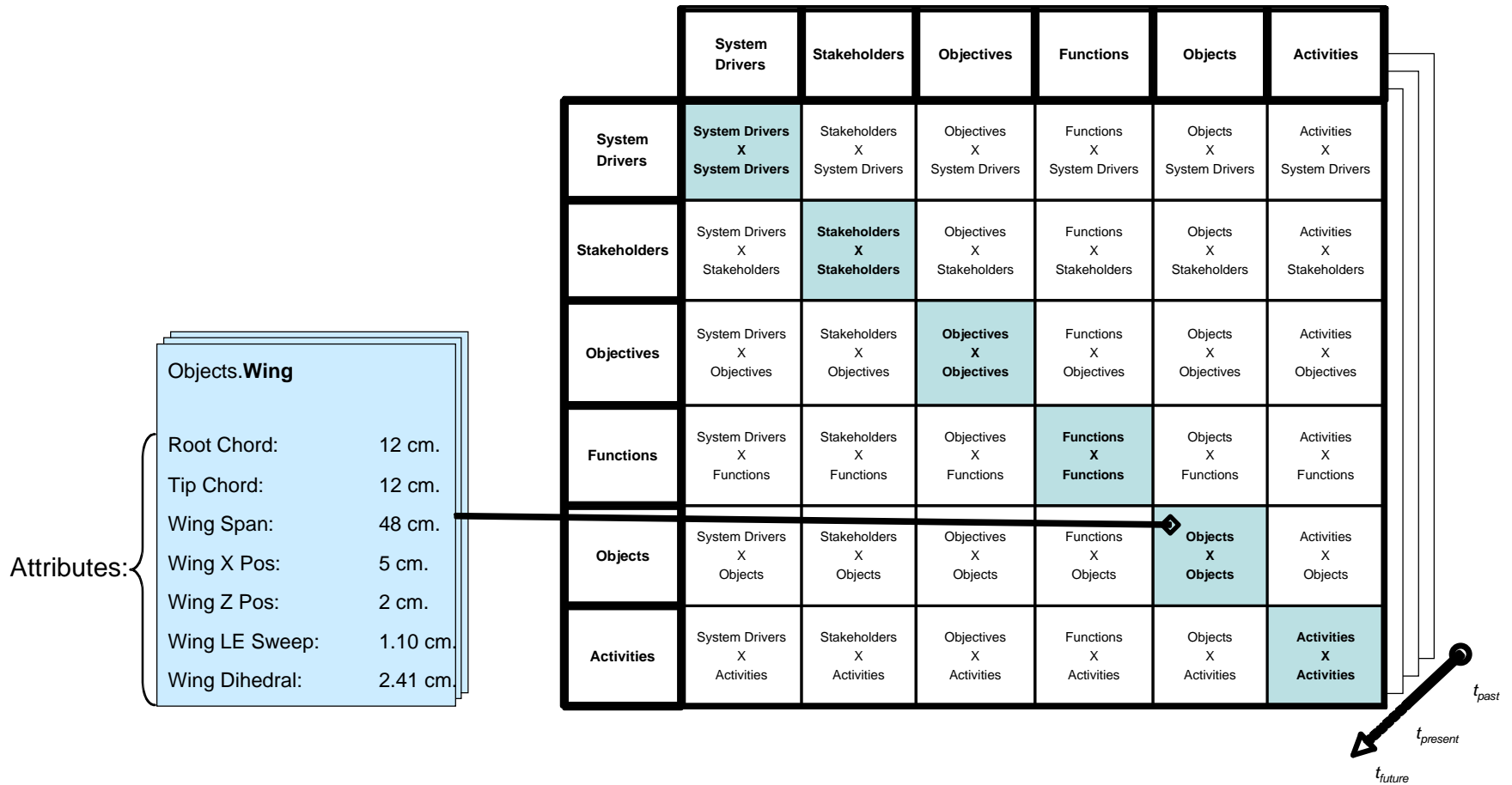


Figure 6

	System Drivers	Stakeholders	Objectives	Functions	Objects	Activities
System Drivers	The list and interactions of exogenous factors that act or acted on by the system	Relates the stakeholders that act on exogenous variables	Relates the objectives that act on exogenous variables	Relates the functions that act on exogenous variables	Relates the technical components that act on exogenous variables	Relates the activities that act on exogenous variables
Stakeholders	Relates the exogenous variables that act on system stakeholders	The list and interactions of the human entities within the system	Relates the objectives that act on stakeholders	Relates the functions that act on stakeholders	Relates the technical components that act on stakeholders	Relates the activities that act on stakeholders
Objectives	Relates the exogenous variables that act on system objectives	Relates the stakeholders that define or contribute to the system objectives	The list and interactions of combined purposes and goals of the system	Relates the functions that act on or relate to system objectives	Relates the technical components that act on system objectives	Relates the activities that act on system objectives
Functions	Relates the exogenous variables that act on system functions	Relates the stakeholders that act on system functions	Relates the objectives that are decomposed into system functions	The list and interactions of functions of the system	Relates the technical components that are traceable to system functions	Relates the activities that act on system functions
Objects	Relates the exogenous variables that act on system technical components	Relates the stakeholders that act on the technical components of the system	Relates the objectives that act on or constrain technical components	Relates the functions that are allocated to technical components	The list and interactions of technical components of the system	Relates the activities that act on technical components
Activities	Relates the exogenous variables that act on the system activities	Relates the stakeholders that engage in or act on the activities of the system	Relates the objectives that act on or constrain system activities	Relates the functions that are allocated to system activities	Relates the technical components that act on system activities	The list and interactions of activities of the system

Figure 7

	System Drivers	Stakeholders	Objectives	Functions	Objects	Activities
System Drivers	TV1 TV2					
Stakeholders		OV4				
Objectives						
Functions	CV2 CV3					
Objects		AV1 CV1	SvcV1 SvcV2 SvcV3 SvcV4 SvcV5 SvcV6 SvcV7 SvcV8 SvcV10	AV1 CV1	SV4	OV3, SV1 SV2, SV3 SV6, SV7 SV8, SV10
Activities	PV1	SV9 SvcV9			SV5	OV2 DIV3, SV10b
						OV5, OV6 OV7, PV2

Figure 8

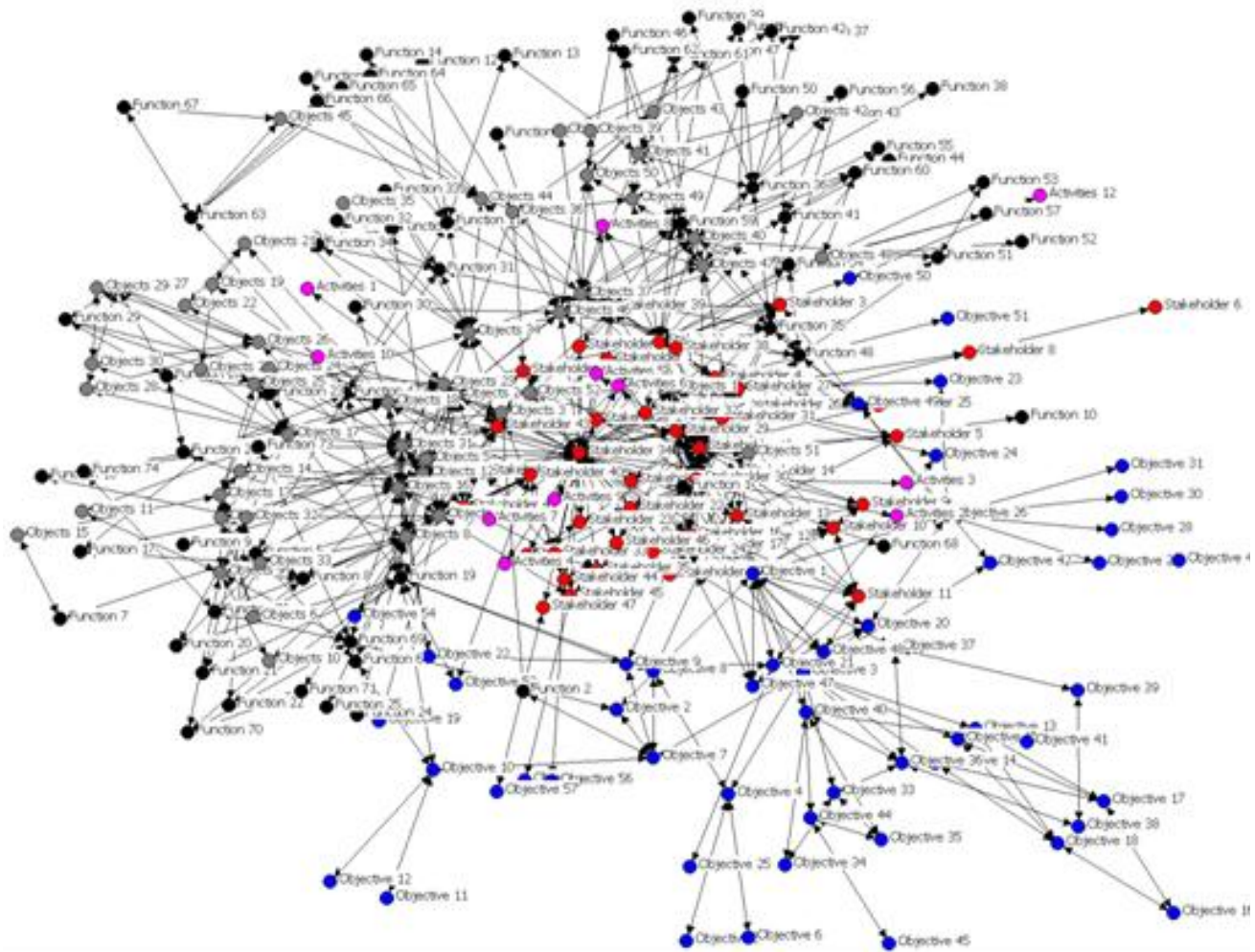


Figure 9

Rank	Objects Network Alone	
1	Engine Subsystem	372.797
2	Ground Station Transmitter	271.913
3	Control Subsystem	243.768
4	Ground Station Subsystem	211.846
5	Ground Station Software	197.242
6	Actuator #1	153.585
7	Wing Subsystem	138.008
8	Battery Connectors	134.774
9	Ribs	127.143
10	Wing Composite Structure	102.837

Rank	MAV-PD	
1	Autopilot Subsystem	1977.195
2	Communication Subsystem (Datalink)	1822.32
3	Ground Station Subsystem	1749.317
4	Air Vehicle	1388.325
5	Wing Subsystem	1298.756
6	Battery Subsystem	1013.186
7	Fuselage Subsystem	1007.738
8	Ground Station Software	992.118
9	Control Subsystem	967.44
10	Fuselage Structure	967.42

Figure 10

Rank	MAV-PD Social Network	Betweenness
1	PMWJ	500.199
2	STCC	199.471
3	PMBI (MAV-PD PM 3)	84.154
4	SPOMD	54.544
5	SPOKE	45.143
6	SPOGR	43.867
7	KTRDM	40.153
8	STYA	21.676
9	STSP	20.47
10	PMFC	15.23

Rank	MAV-PD Entire Network	Betweenness
1	PMWJ	10972.993
2	KTRDM	3680.017
3	KTRNM	1972.081
4	STCC	1556.707
5	PMBI (MAV-PD PM 3)	1372.588
6	KTRRC	1004.062
7	KTRIT	618.312
8	KTRBR	390.463
9	SPOMD	293.354
10	STYA	275.212

Arrows indicate the following mappings:

- Rank 3 in Social Network (PMBI) maps to Rank 5 in Entire Network (PMBI).
- Rank 7 in Social Network (KTRDM) maps to Rank 2 in Entire Network (KTRDM).

Figure 11

PMWJ	Time 1	Time 2	Time 3	Time 4
Degree Centrality	38	46	61	53
Betweenness	3643	5427	11836	10331

STCC	Time 1	Time 2	Time 3	Time 4
Degree Centrality	16	21	28	23
Betweenness	820	866	1667	3501

MAV-PD Avgs	Time 1	Time 2	Time 3	Time 4
Degree Centrality	4.87	4.93	4.7	4.96
Betweenness	238	258	280	296

PM and ST Replacements

Time 5
8
1769.191

4
240.846

3.777
338.777

Figure 12

Network	Type	# of nodes	# or relations	avg. degree	avg. path length	Rand Grph theo I	Clus. Coef	Clus. Coef	Rand Grph theo C
		n	m	$\langle k \rangle$	l	$\frac{\log n}{\log \langle k \rangle}$	$C^{(1)}$	$C^{(2)}$	$\langle k \rangle / n$
Technological									
Internet	undirected	10 697	31 992	5.98	3.31	5.19	0.035	0.39	0.0005
power grid	undirected	4 941	6 594	2.67	18.99	8.67	0.1	0.08	0.0004
Train routes	undirected	587	19 603	66.79	2.16	1.52		0.69	0.12
software packages	directed	1 439	1 723	1.2	2.42	39.81	0.07	0.082	0.0008
software classes	directed	1 377	2 213	1.61	1.51	15.18	0.033	0.012	0.0012
electronic circuits	undirected	24 097	53 248	4.34	11.05	6.87	0.01	0.03	0.0002
peer-to-peer network	undirected	880	1 296	1.47	4.28	17.6	0.012	0.011	0.002
BOSTON T	undirected	81	3684	45.48	1.887	1.15	0.94	0.857	0.565
Biological									
Silwood Park Food Web		154		4.75	3.4	3.23266053	0.15	0.03	0.03084416
C. Elegans		282		14	2.65	2.13784938	0.28	0.05	0.04964539
Social Networks									
Movie Actors	undirected	225226		61	3.65	2.99811184	0.79		0.00027084
LANL Coauthorship	undirected	52909		9.7	5.9	4.78685129	0.43		0.00018333
MAV-PD Time 1	undirected	184	884	4.87	3.61	3.2941417	0.293	0.209	0.02646739
MAV-PD Time 2	undirected	196	956	4.93	3.665	3.30845964	0.314	0.2	0.02515306
MAV-PD Time 3	undirected	262	1232	4.702	3.621	3.59714977	0.316	0.196	0.01794656
MAV-PD Time 4	undirected	223	1106	4.96	3.667	3.37651579	0.299	0.19	0.02224215
MAV-PD Time 5	undirected	206	778	3.77	4.437	4.01475136	0.221	0.126	0.01830097

Figure 13

Minimize (- Endurance, Longest Linear Dimension)

Where:

$$1. \text{ Endurance} = \frac{L/D_{\max} \times e_{\text{engine}} \times \eta_{\text{prop}} \times \eta_{\text{motor}} \times V_{\text{trim}}}{9.81 \times m_{\text{MAVnoengine}}} \times 1000$$

$$2. S_{\text{LinDim}} = \sqrt{b_{\text{wing}}^2 + \left(\frac{S_{\text{wing}}}{b_{\text{wing}}}\right)^2} \quad \text{Where: } S_{\text{wing}} = \frac{b_{\text{wing}}}{2} \times c_{r_wing} \times \left(1 + \frac{c_{t_wing}}{c_{r_wing}}\right)$$

Figure 14

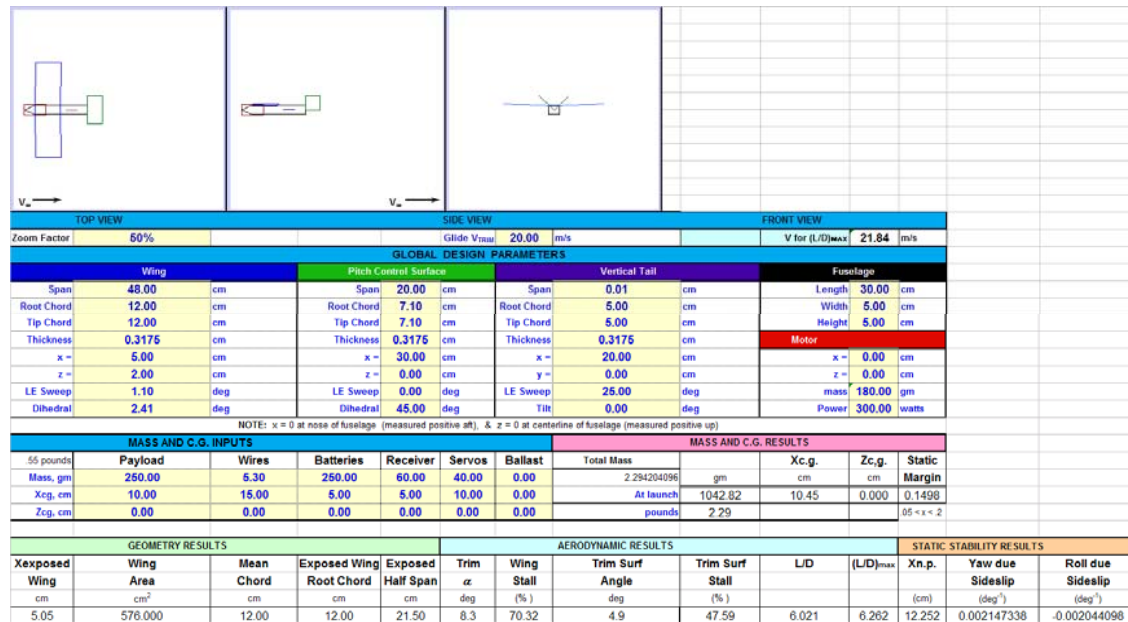


Figure 15

