Systems Lessons from the Panama Canal

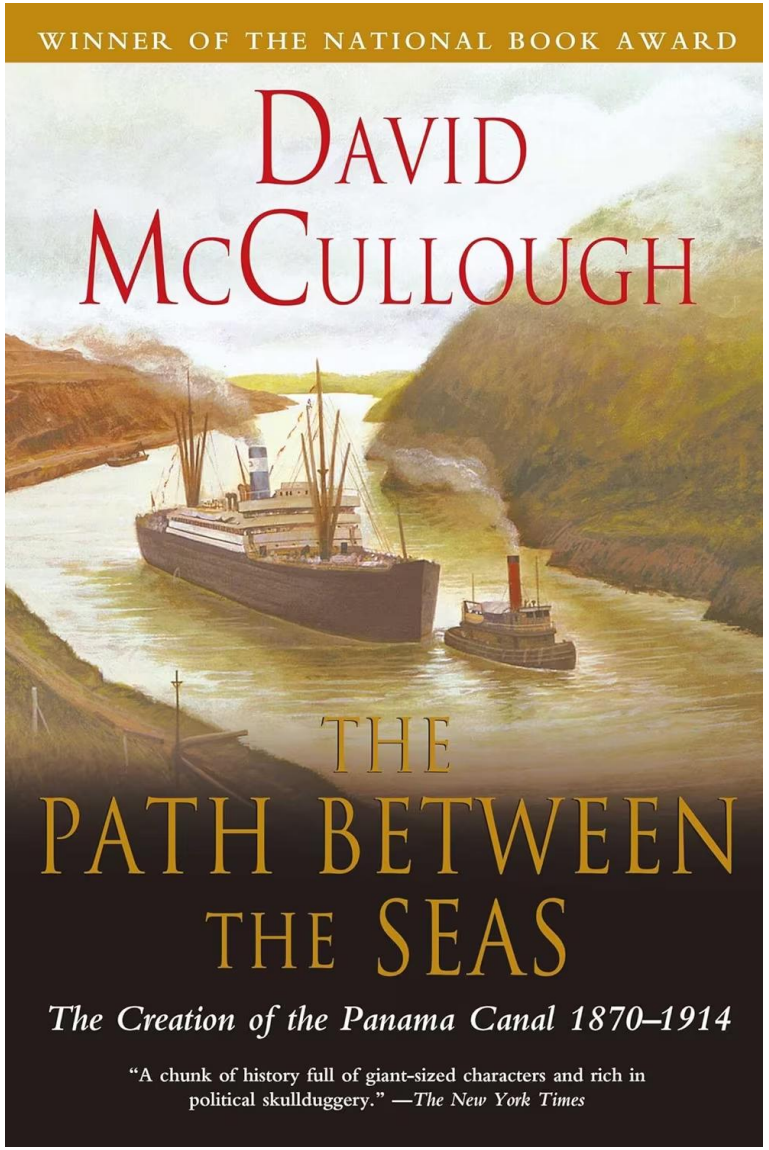
Richard Beasley, CEng, ESEP
RB Systems (richard@rbsystems.net)



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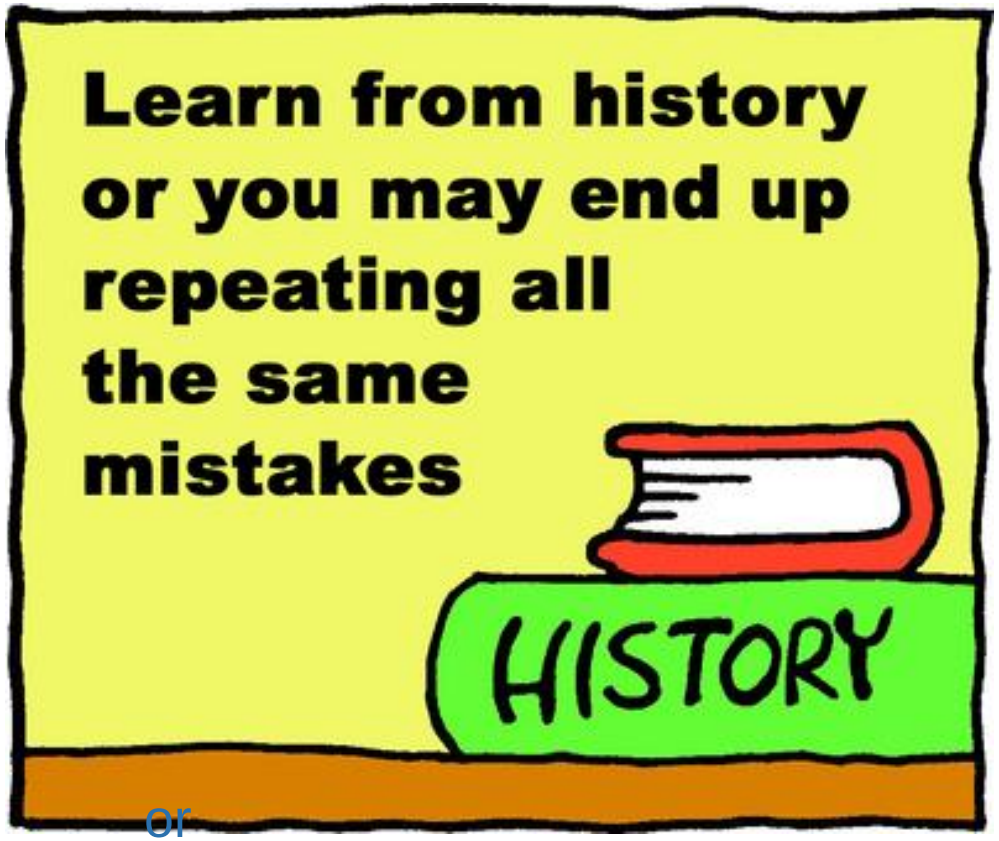
Introduction

Panama Canal



Main source reference

Why study?



or

Repeat the same successes!

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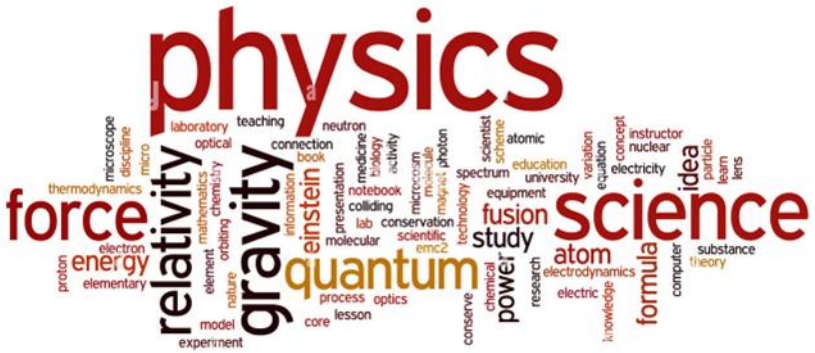


Richard Beasley Introduction

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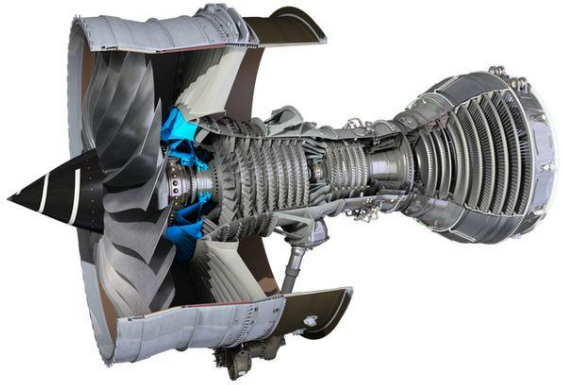
University / Academic

University of BRISTOL



B.Sc. Physics
1983-1986

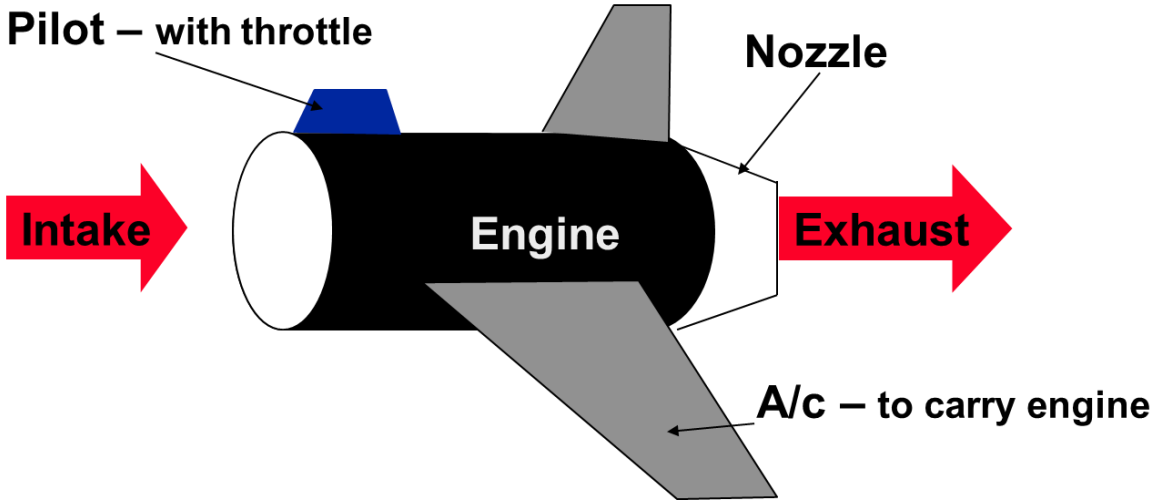
Cranfield University



M.Sc. Gas Turbine Engineering
1992-1996 (part-time)

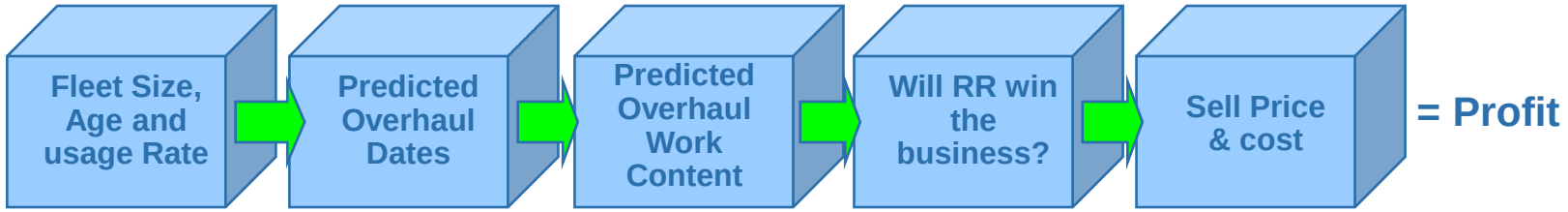
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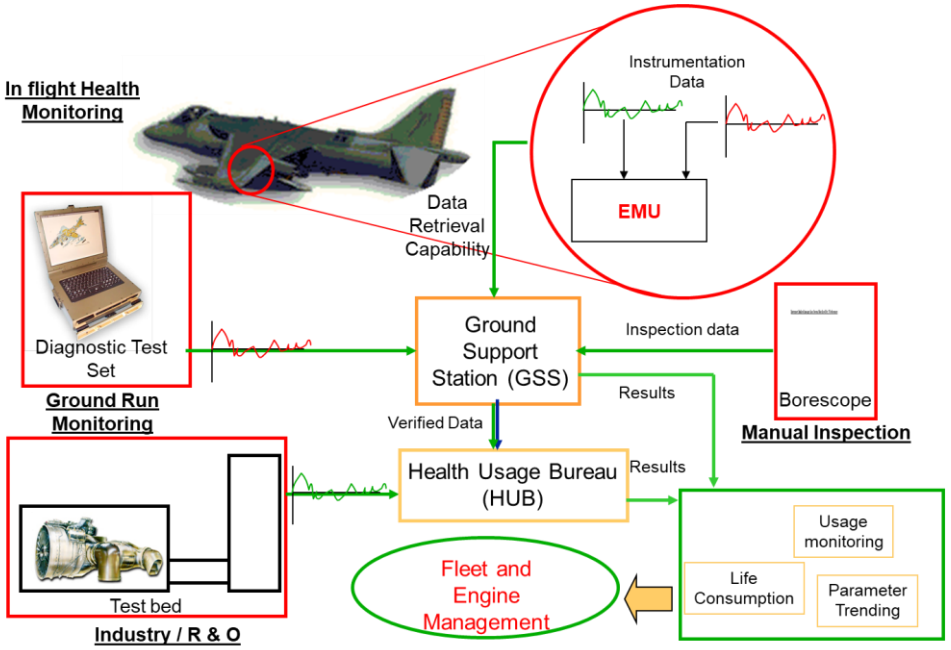
Rolls-Royce – Installations (1986-2001)



Stealth Technology

Rolls-Royce – Life Cycle Cost / Health Monitoring – 2001-2006





And then…..in 2005

BURGE HUGHES WALSH

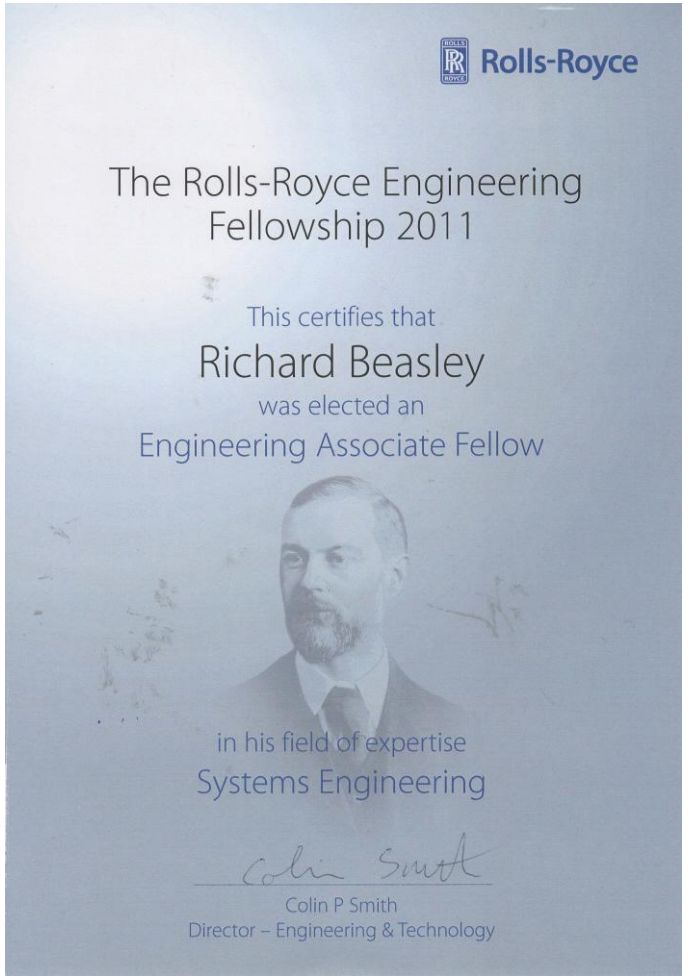
Systems Engineering
One Week Course

Systems Engineering at R-R

2006-07 Head of Systems Engineering (Defence)

2007-11 Global Chief of Systems Engineering

2011-24 Associate Fellow – Systems Engineering

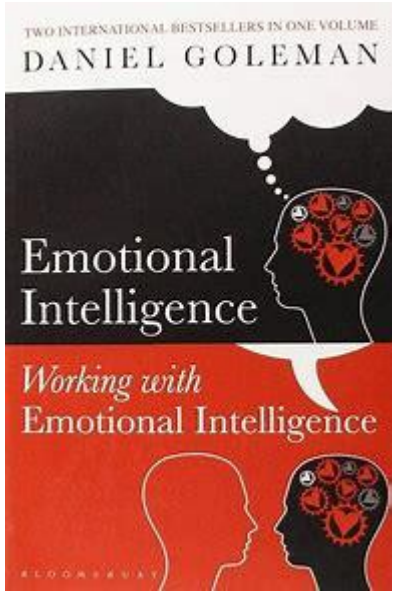


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It wasn’t all easy!





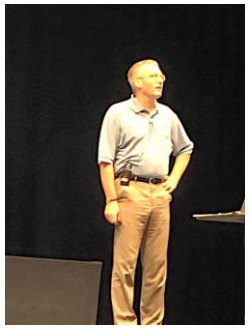


INCOSE

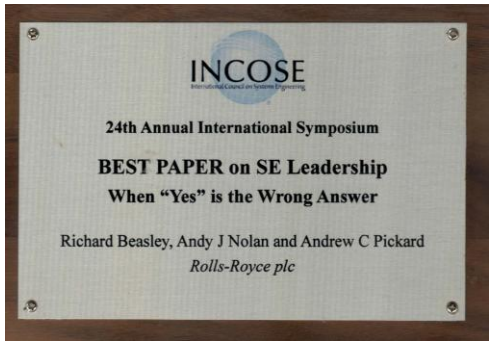
2006 Joined

2014-16 President UK Chapter

2022-24 Director of Services

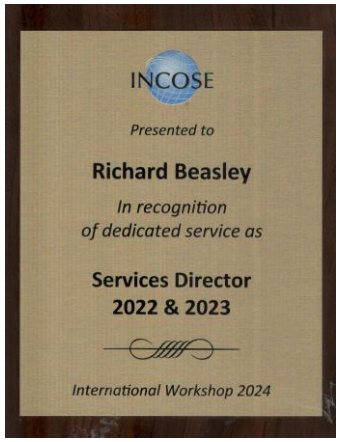


2016 IS Edinburgh MoC



Lots of IS papers (30 (!) since 2008

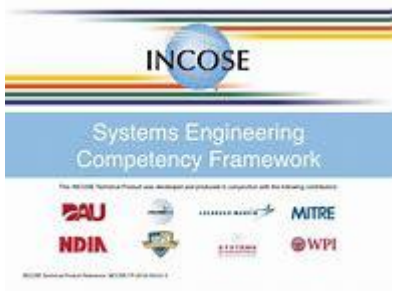
Awarded 2017



PDP PROFESSIONAL DEVELOPMENT PORTAL

INCOSE VIRTUAL COMMUNITY

SEBoK GUIDE TO THE SYSTEMS ENGINEERING BODY OF KNOWLEDGE



Lead author on these



2017 IS Adelaide



Last time I was in Stockholm (Nordic tour 2018)

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Retired from RR 31 May 2024
37 years, 8 ½ months





RB SYSTEMS

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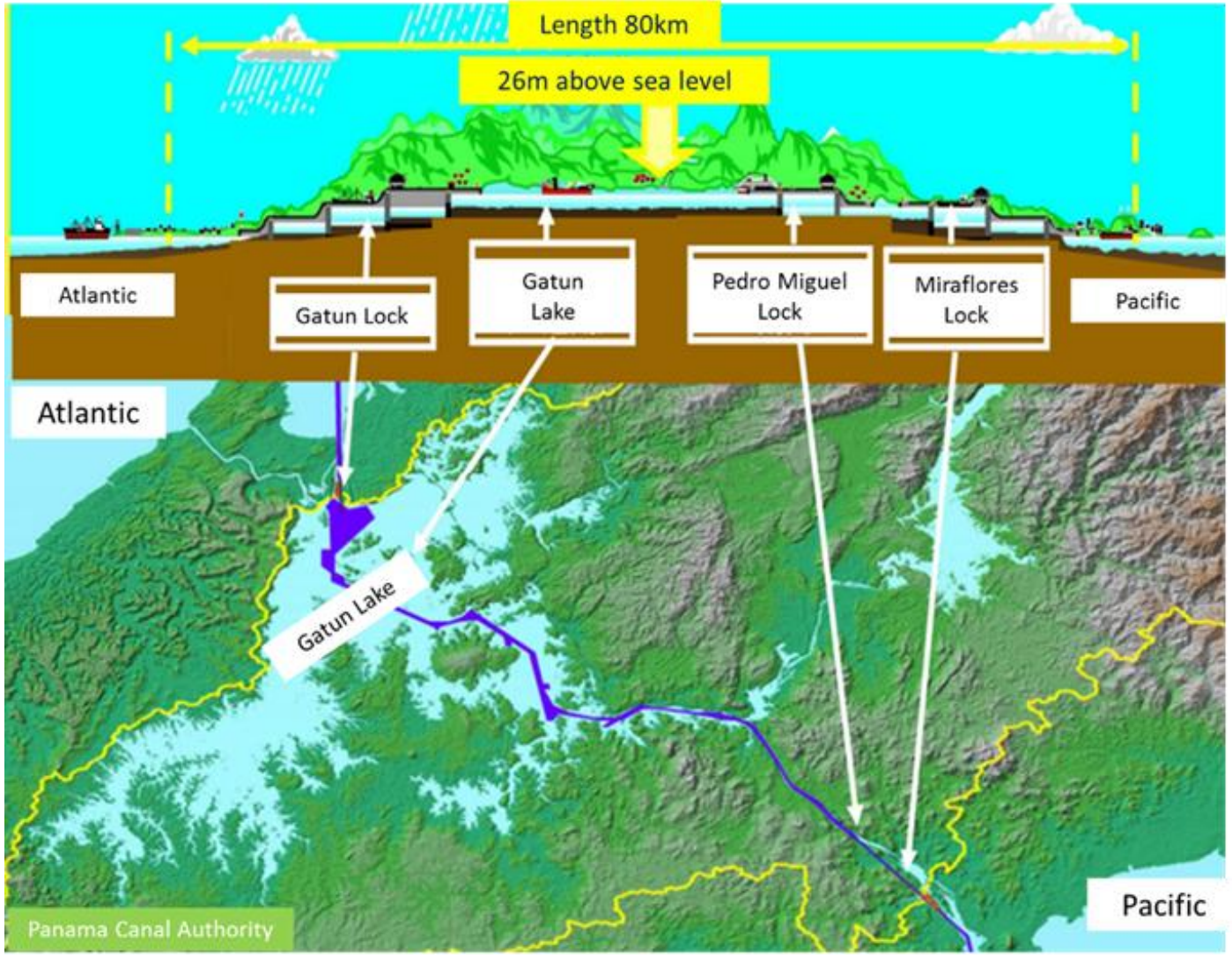
Introduction to the Panama Canal

©RBSystems

Panama Canal – Geography (1)

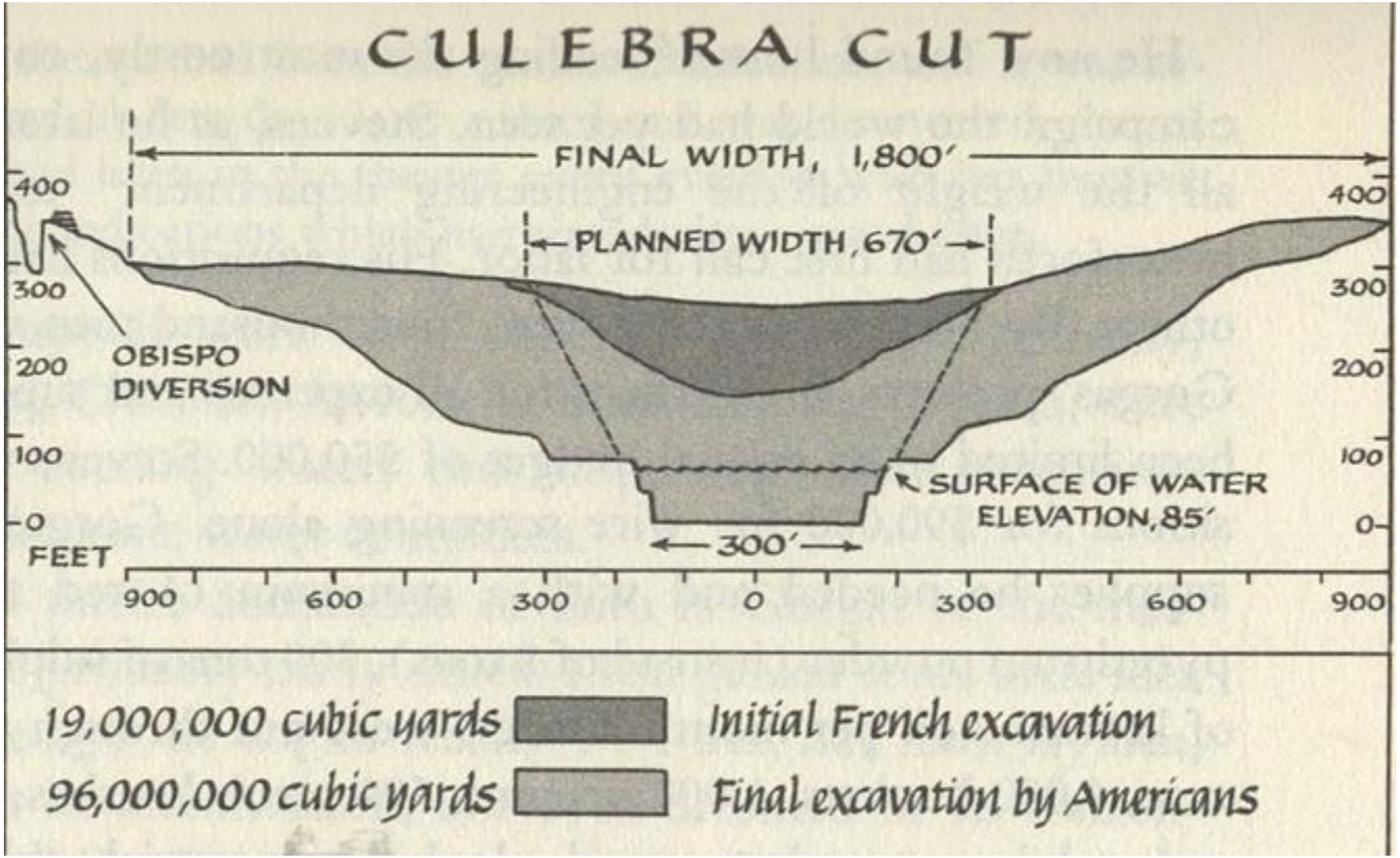


Panama Canal – Geography (2)



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Panama Canal – Geography (3)



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Key dates from History of Panama canal (1)
Pre-canal

1513

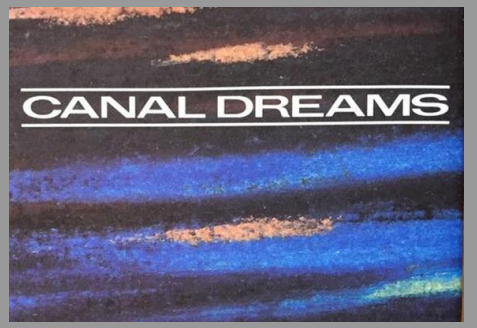
First European view of Pacific Ocean





Vasco Nunez de Balboa

From - Vasco Núñez de Balboa - WikipediHa



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Key dates from History of Panama canal (2)

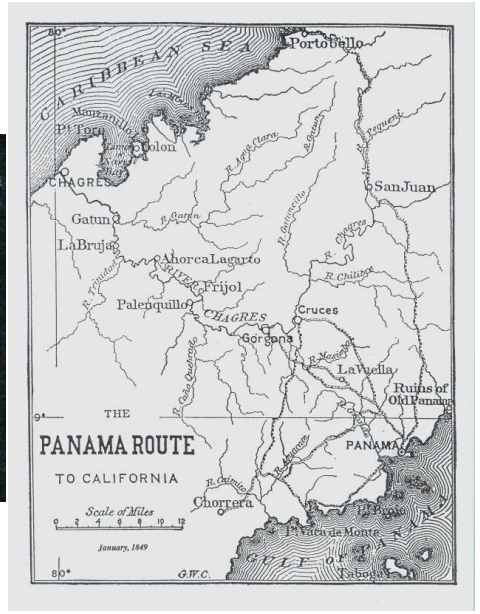
Pre-canal

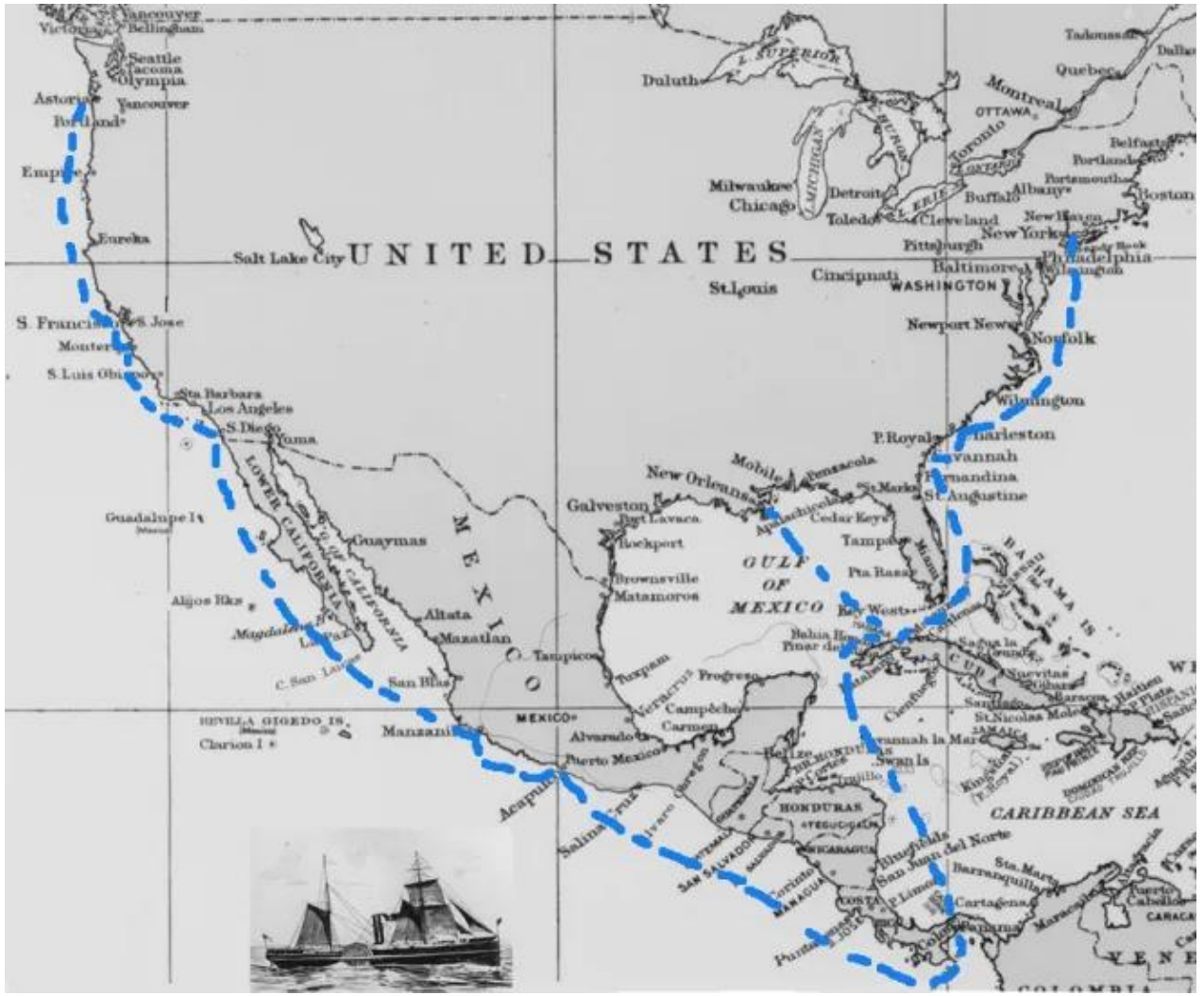
1855

Panama Railway built

(California Goldrush)







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Key dates from History of Panama canal (3) French Project

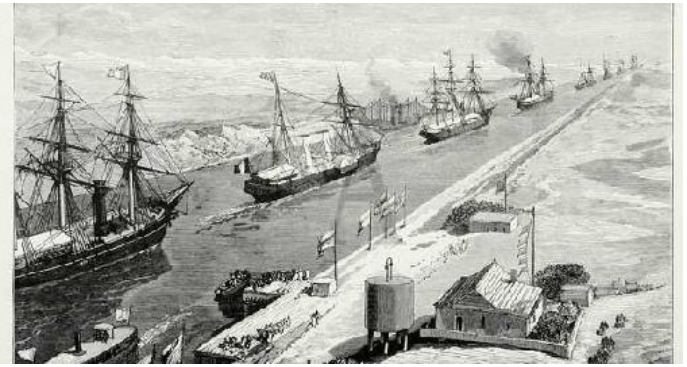
1867 – Suez Canal

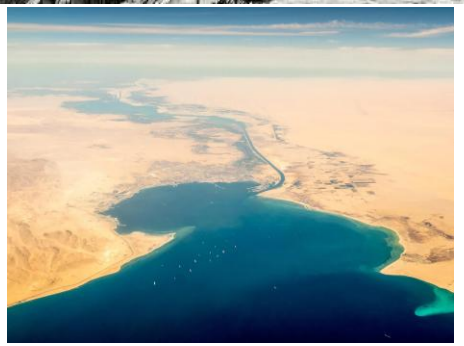
1880s – French company trying to build sea level canal

- Disastrous financial failure
- 1000s died of malaria

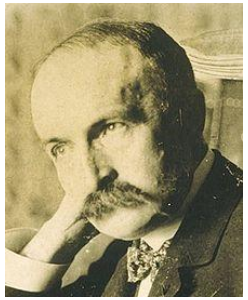


Ferdinand de Lesseps
From - Ferdinand de Lesseps - Wikipedia









Phillipe-Jean Bunau-Varilla
From Philippe Bunau-Varilla - Wikipedia

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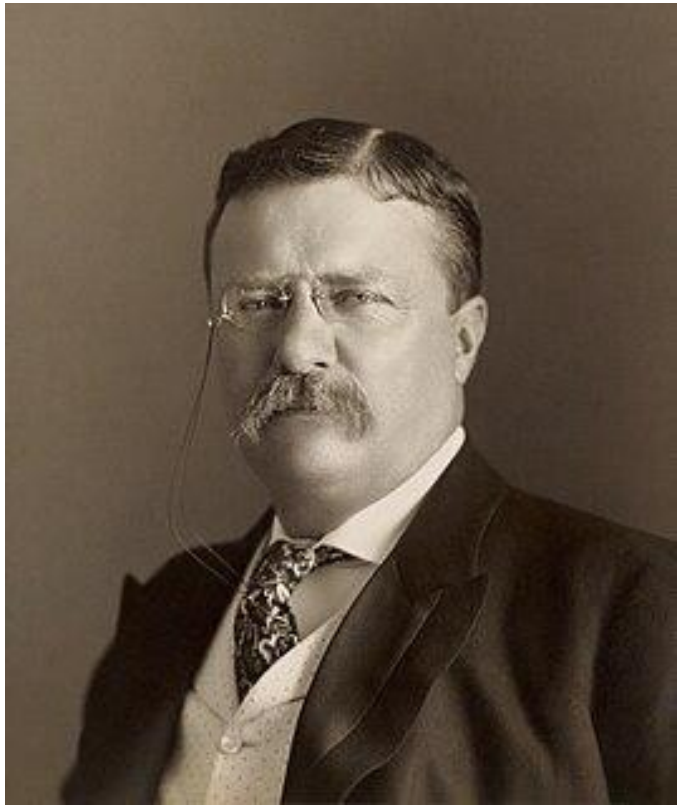
Key dates from History of Panama canal (4)
US project – preparation

1897 – Cause of malaria found

1899 – Roosevelt wanted canal

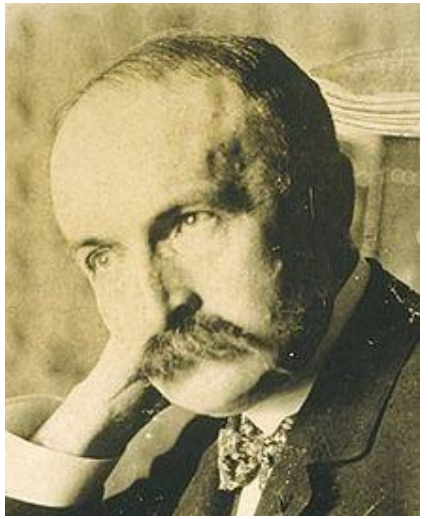
1902 – Spooner Act passed - Panama route, purchasing

1903- Revolution separating Panama from Columbia



Theodore Roosevelt
From Theodore Roosevelt - Wikipedia

Phillipe-Jean Bunau-Varilla
From Philippe Bunau-Varilla - Wikipedia



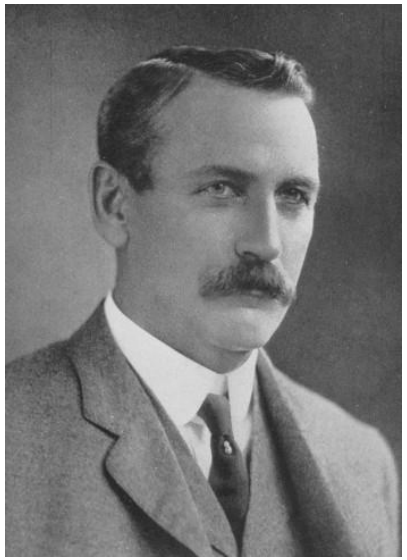
Key dates from History of Panama canal (4) US project

1904 - 1914 Construction of canal by US

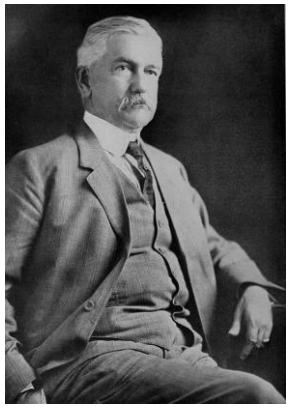
1914 – First ship transit



John Wallace
Chief Engineer 1904-5
From John Findley Wallace - Wikipedia



John Stevens
Chief Engineer 1905-7
From John Frank Stevens - Wikipedia



William Gorgas
From Theodore Roosevelt - Wikipedia



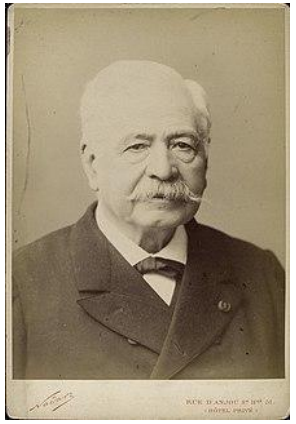
George Goethals
Chief Engineer 1907-14 and 1st Governor Panama Canal Zone
From George Washington Goethals - Wikipedia

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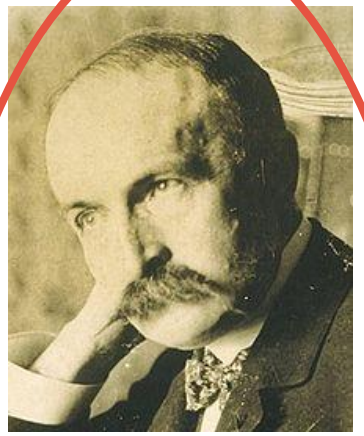
Key Panama Characters (dramatis personae)



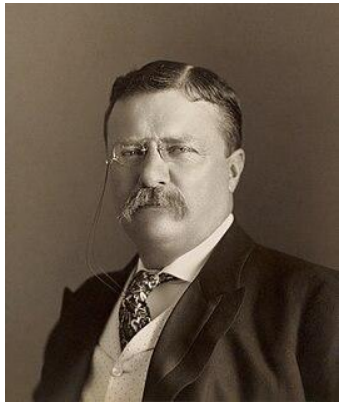
Vasco Nunez de Balboa
From - Vasco Núñez de Balboa - WikipediHa



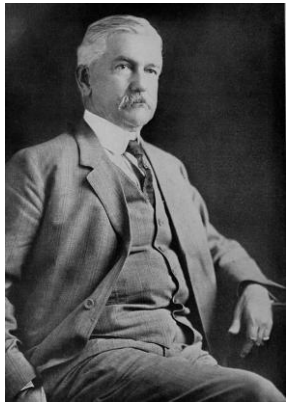
Ferdinand de Lesseps
From - Ferdinand de Lesseps - Wikipedia



Phillipe-Jean Bunau-Varilla
From Philippe Bunau-Varilla - Wikipedia



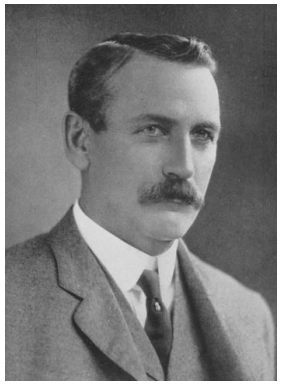
Theodore Roosevelt
From Theodore Roosevelt - Wikipedia



William Gorgas
From Theodore Roosevelt - Wikipedia



John Wallace
Chief Engineer 1904-5
From John Findley Wallace - Wikipedia



John Stevens
Chief Engineer 1905-7
From John Frank Stevens - Wikipedia



George Goethals
Chief Engineer 1907-14 and 1st Governor Panama Canal Zone
From George Washington Goethals - Wikipedia

My favorites!

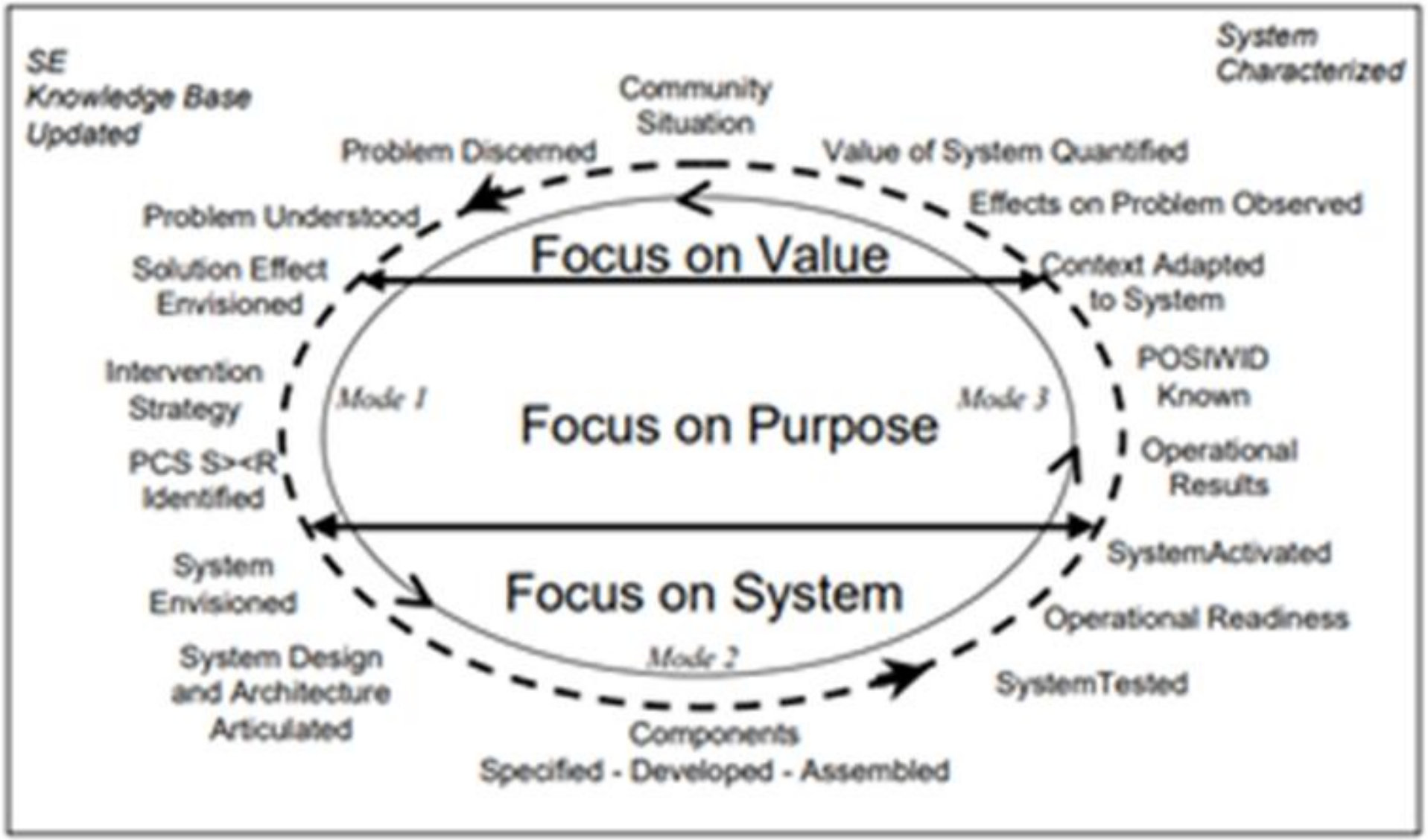
Systems principles and lessons observed from Panama Canal Construction

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Every system has

PURPOSE

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Model is Jack Ring's Value Cycle

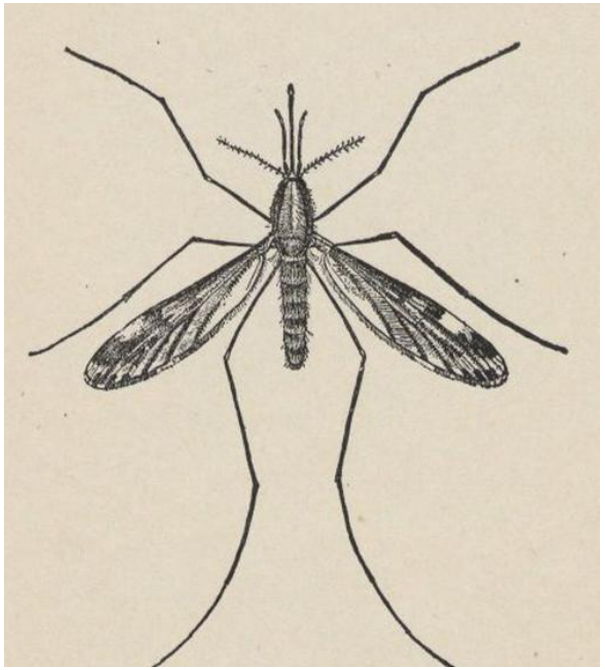
Ring, J, 1998, Value-seeking approach to the engineering of systems, Proceedings of the IEEE International Conference on Systems, Man and Cybernetics 3 (3), 2704-2708

Every system

IS INFLUENCED BY / INFLUENCES ITS ENVIRONMENT

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Environment is an important “stakeholder”



Anopheles –
Malaria vector



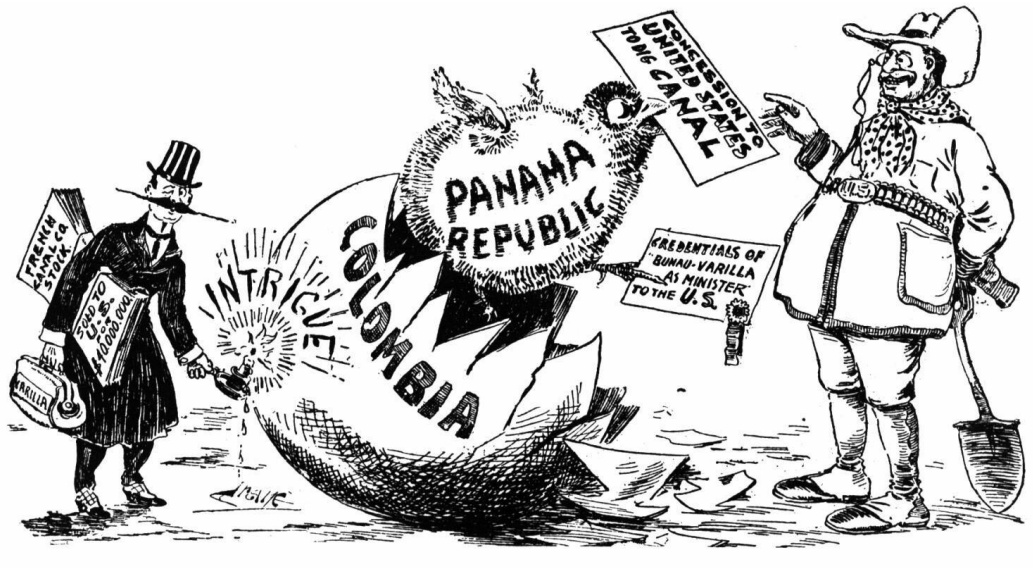
Stegomyia –
Yellow fever vector

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Every system is

PART OF A LARGER SYSTEM

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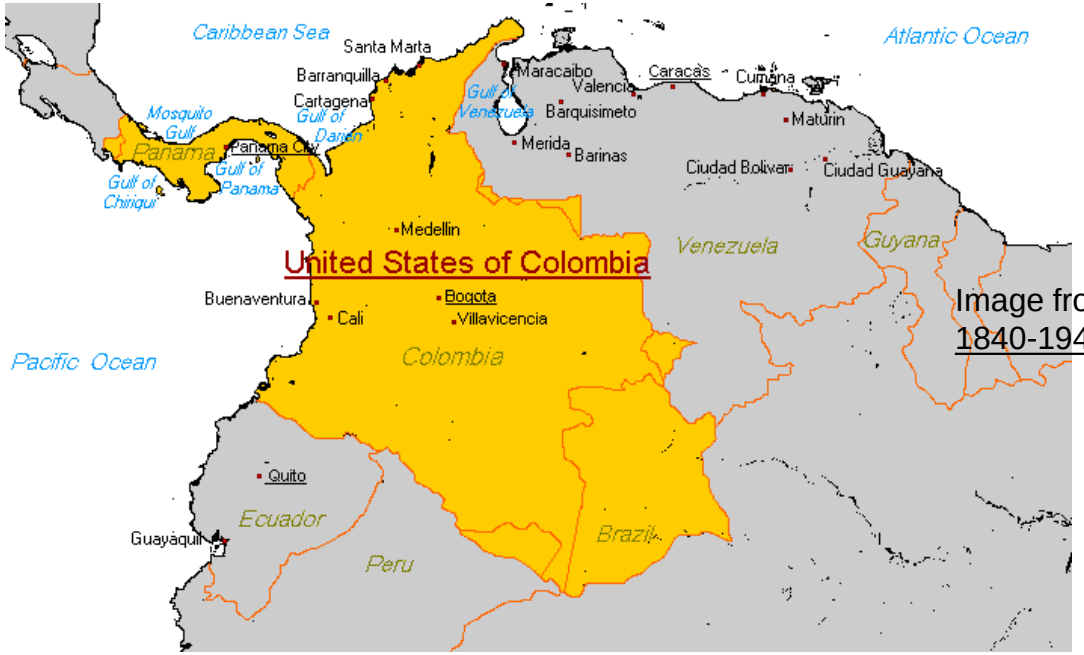
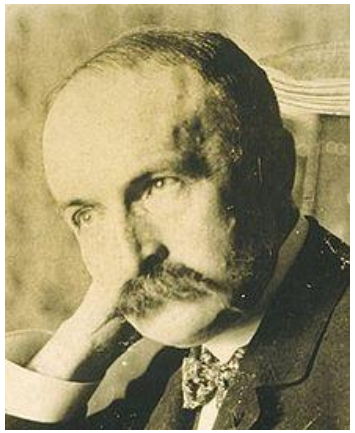
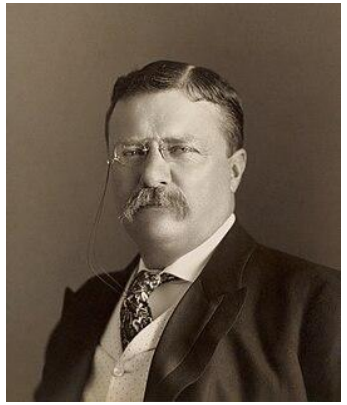


Image from Big Blue 1840-1940: Panama



Phillipe-Jean Bunau-Varilla
From Philippe Bunau-Varilla - Wikipedia



Theodore Roosevelt
From Theodore Roosevelt - Wikipedia

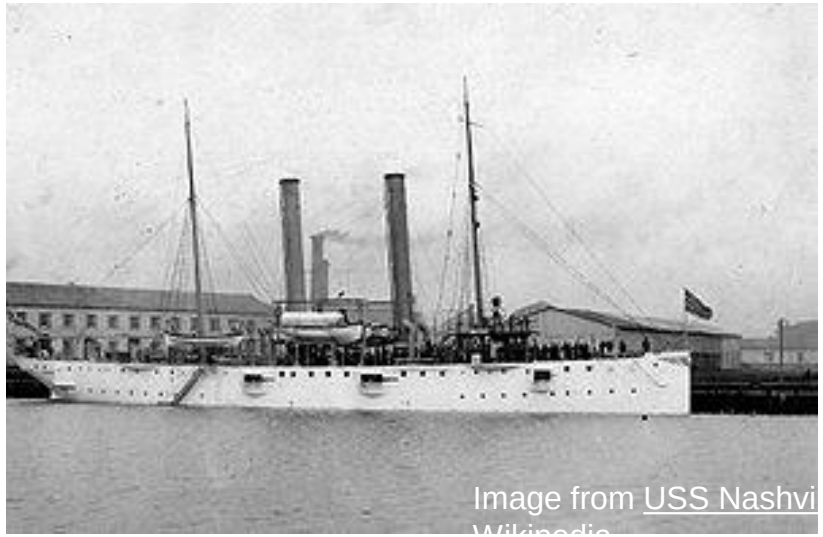


Image from USS Nashvi
Wikipedia

USS Nashville

Every system has

EMERGENCE

Malaria



Image from: Sarah J. Moore, "Mosquitoes, Malaria, and Cold Butter: Discourses of Hygiene and Health in the Panama Canal Zone in the Early Twentieth Century," *Panorama: Journal of the Association of Historians of American Art* 3, no. 2 (Fall 2017), https://doi.org/10.24926/24716839.1603

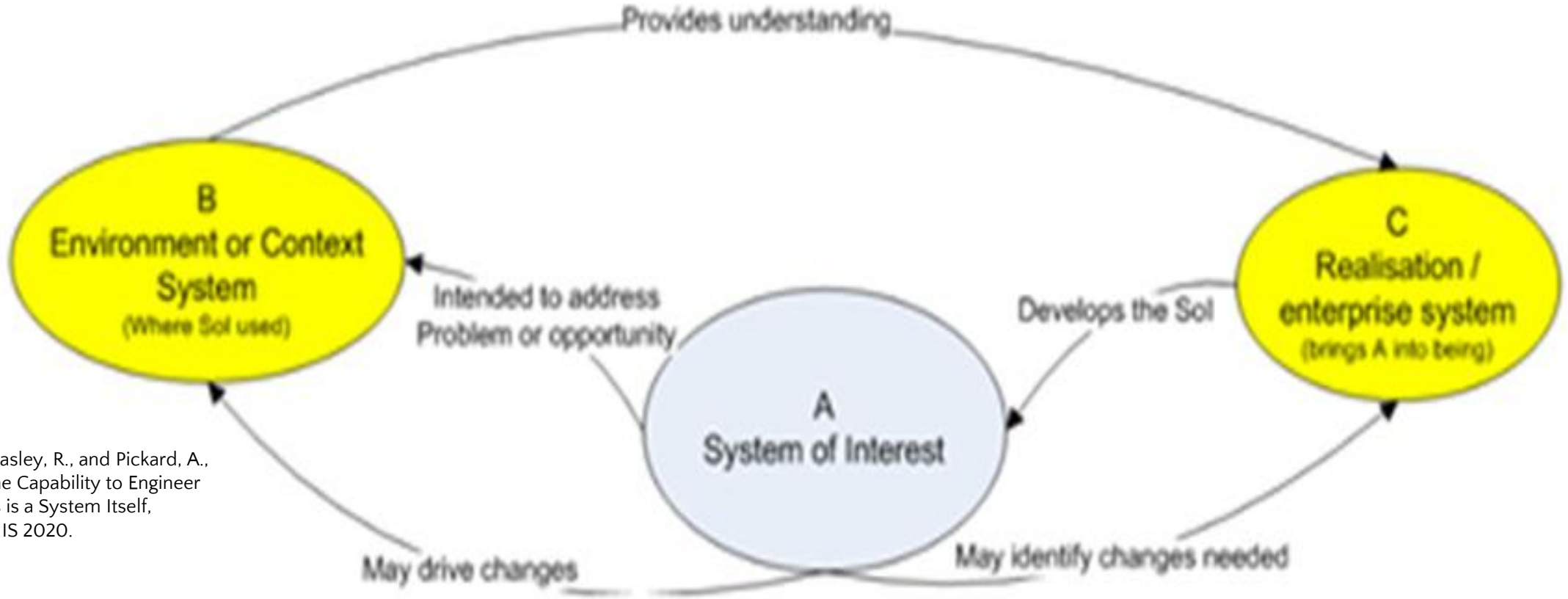
French "money pit"



Every system needs

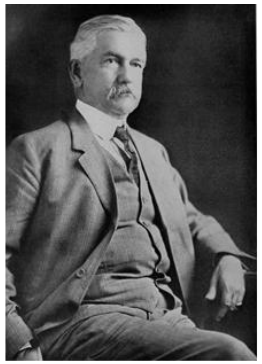
REALISATION SYSTEMS

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From Beasley, R., and Pickard, A., 2020 The Capability to Engineer Systems is a System Itself, INCOSE IS 2020.

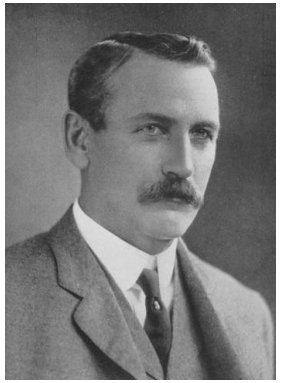
Sanitation



William Gorgas
From Theodore Roosevelt - Wikipedia

Logistics

"Digging is least of all"

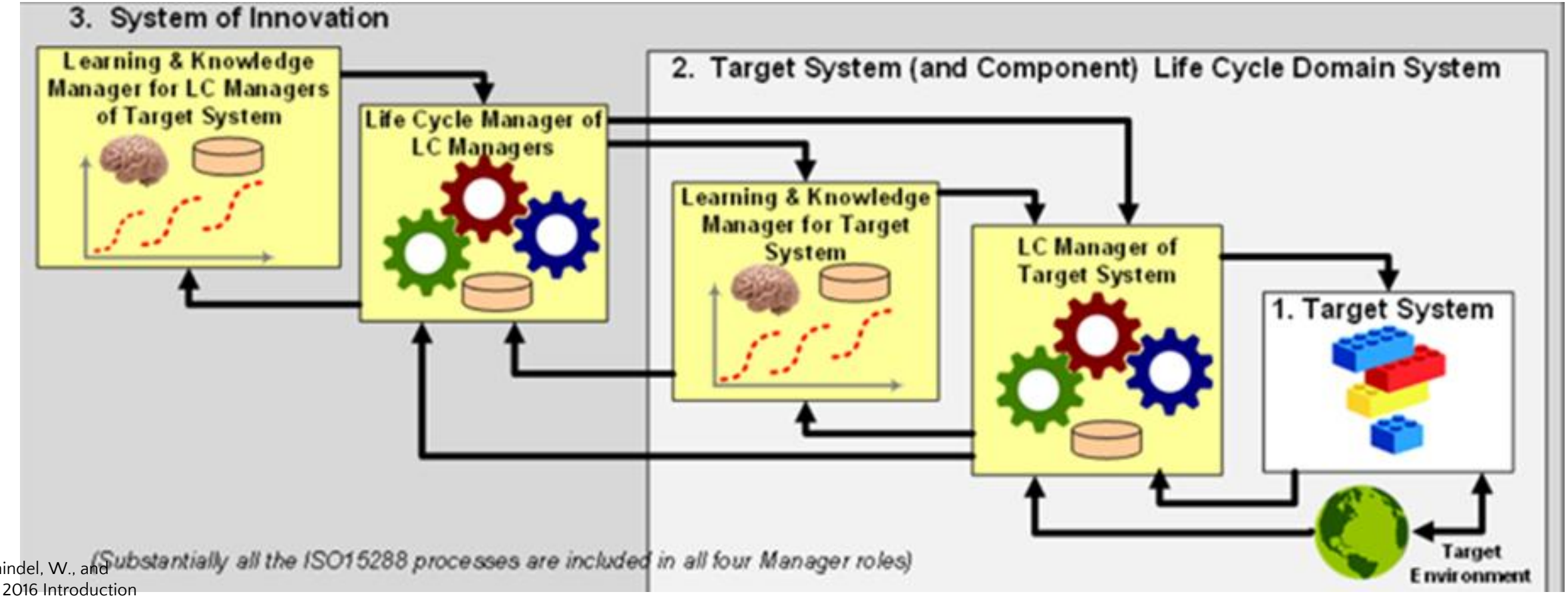


John Stevens
Chief Engineer 1905-7
From John Frank Stevens - Wikipedia

Every system is

MORE THAN TECHNICAL SOLUTION

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From Schindel, W., and Dove, R., 2016 Introduction to the Agile Systems Engienering Life Cycle MBSE Pattern, INOCSE IS 2016

Need to understand the technology and organisation needed to deliver canal

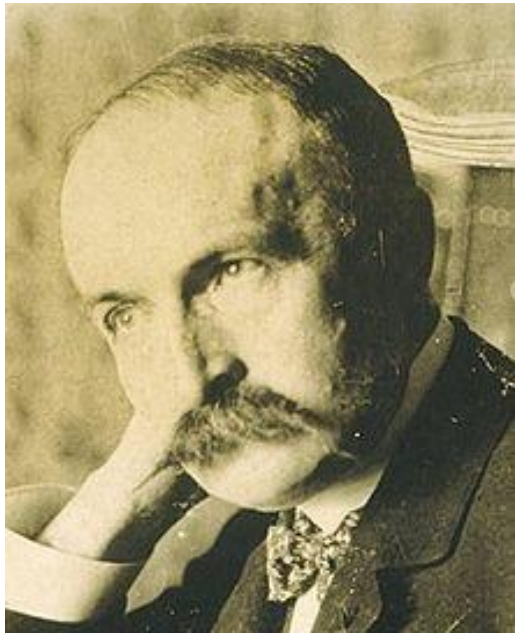
Every system development project needs

DECISIONS AND LEADERS

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US Senate

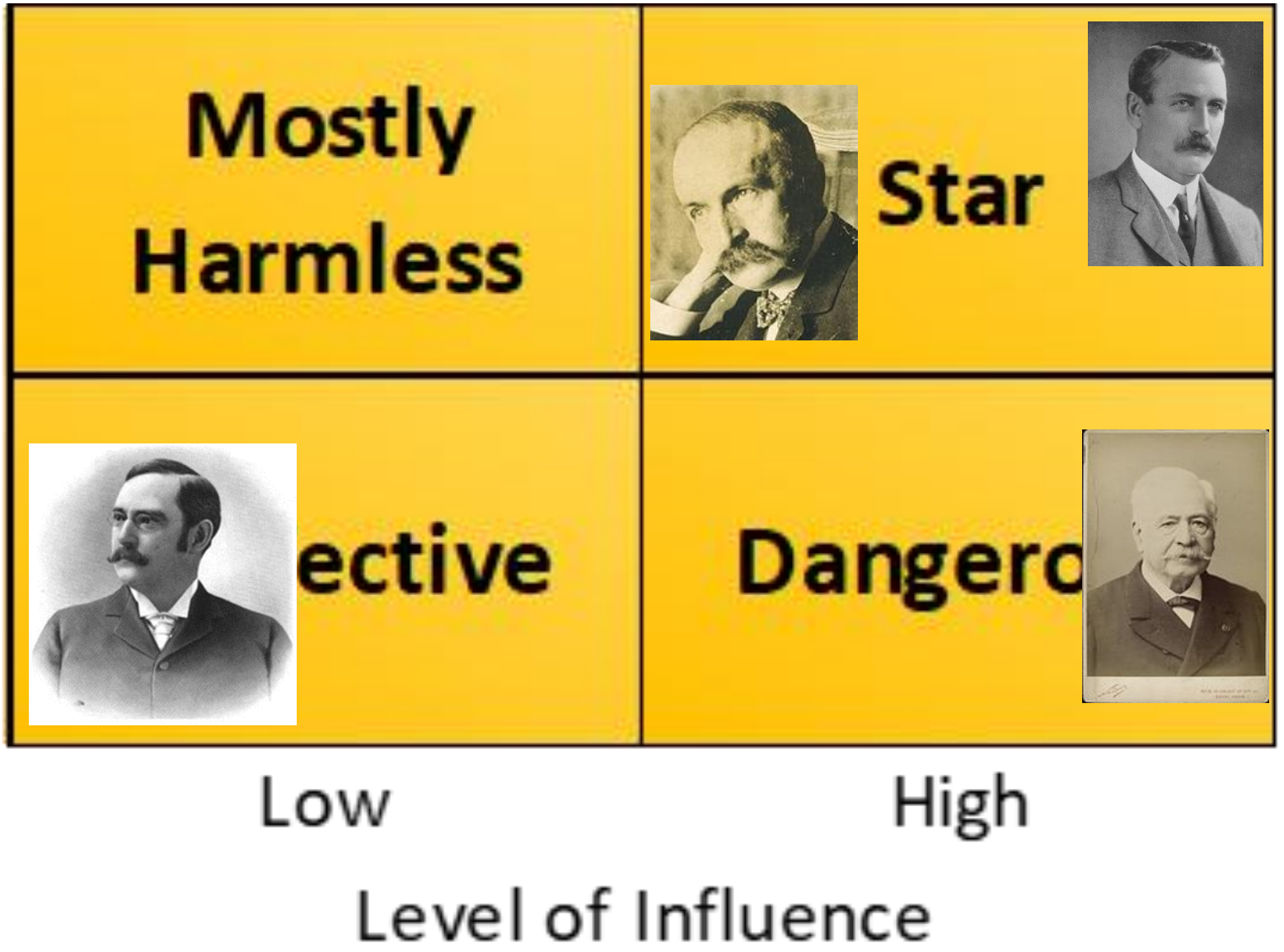


Phillipe-Jean Bunau-Varilla
From Philippe Bunau-Varilla - Wikipedia



Stamp that Changed History: How the Panama Canal was Almost the Nicaragua Canal, blog entry on Smithsonian National Postal Museum website

From Kemp
O'Neil, 2019
Principles fo
leaders, INC
Internationa
Symposium







Every system has a

LIFECYCLE



Original Canal built larger than ships of time

2006-2016
$5.25Bn in giving a third lane

By US DOT - https://www.transportation.gov/fastlane/expanded-canal-means-an-expanded-economy, Public Domain, https://commons.wikimedia.org/w/index.php?curid=54989250

Summary / Conclusions

Summary Systems Lessons

1. Purpose
2. Environment
3. Larger System
4. Emergence
5. Realization Systems
6. Technical Solution
7. Decisions and Leaders
8. Lifecycle

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Concluding comments

Important to learn lessons from history

Systems are always about the people creating them



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Final thought



Far better it is to dare mighty things, to win glorious triumphs, even though checkered by failure, than to take rank with those poor spirits who neither enjoy much nor suffer much, because they live in the grey twilight that knows not victory or defeat

- Theodore Roosevelt

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richard@rbsystems.net

Syntell SE Summer School 2024

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