Risk Management Using STPA Restarting Widget Production

STAMP Workshop, MIT March 26, 2019

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LLNL-PRES-LLNL-PRES-770080

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. Lawrence Livermore National Security. LLC

The Problem

 Government would like to restart the production of widgets which have not been produced for 30 years.

 Could STPA be useful for identification of risks on the production restart?

Typical Risk Management Process

- 1. Identify the Risk
- 2. Assess the Risk
- 3. Develop Reponses to the Risk
- 4. Develop Contingency Plan, Preventive Measures



Identifying Risk

- Brainstorming
- Interviews (SMEs, Stakeholders)
- 3. Similar Projects (Historical Records, Lessons Learned)
- Diagramming Techniques (Fish Bone, What if, Pictorial Modeling)
- Risk Identification Checklist
- 6. STPA (Systemic Theoretic Process Assessment)?

Assess the Risk

- Magnitude of Impact
 - Public Safety
 - Worker Safety
 - Financial Loss
 - Delay
 - Trivial
- Probability of Occurrence
 - Multiple
 - Infrequent
 - Not Yet



Develop Responses to the Risk

Status

Identified

Active

Closed

Unassigned

Risk Response

Leave It

Monitor

Avoid

Move

Mitigate

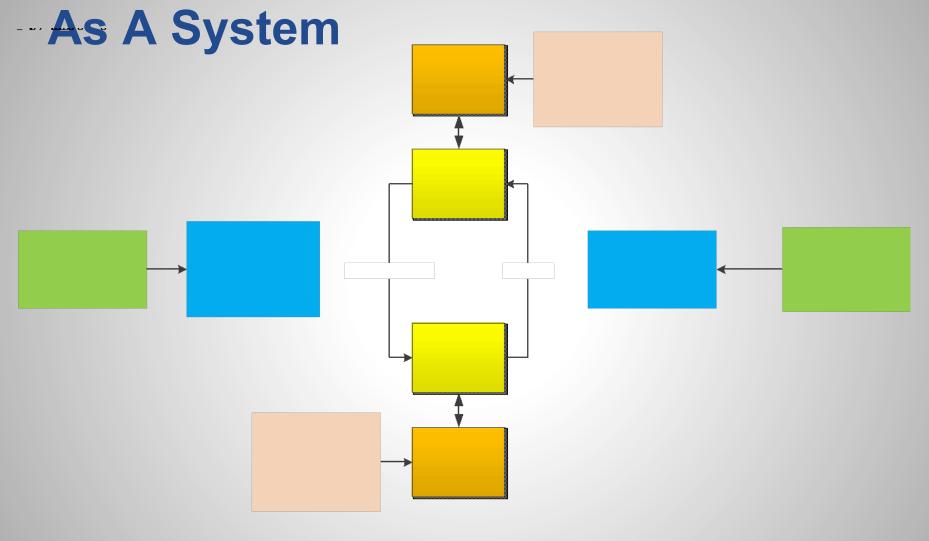
Unassigned



STPA Process

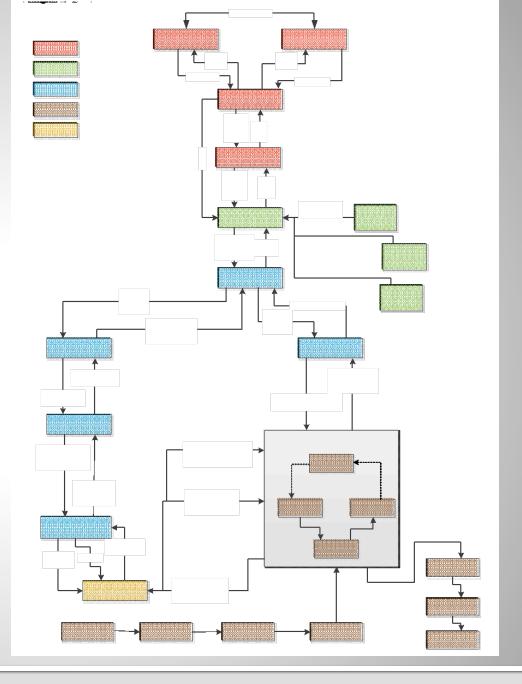
- 1. Find experienced domain experts in widget design, test, and production.
- 2. Create a Hierarchal Structure Chart for the organizations involved.
- 3. Develop guide phrases
- 4. Apply guide phrases to each interface in the Hierarchal Structure Chart to identify risks.
- 5. Capture risks, prioritize, suggest mitigations.

Organizational Components



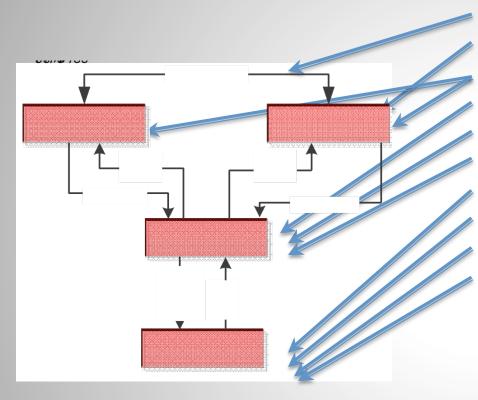


Hierarchical Control Structure Chart





Government Entity Risks



GR1. Sequestration, Gov. Shut Down

GR2. Congressional fund reallocation

GR3. Congress/Executive Delays

GR4. Congress Privatization of Site

GR5. Automation Competency

GR6. Sec./oversight Turnover

GR7. Oversight Automation Experience

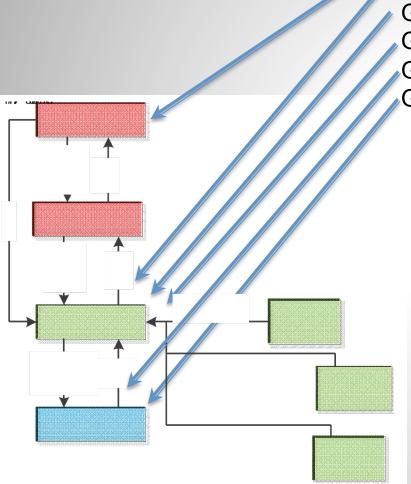
GR8. Oversight Budget Concerns

GR9. Oversight Diff. Tech opinion with Sites

GR10. Personal Opinions Over Experience



Government, Privatizing, Site Risks



GPSR1. Funding from Secretary, Not oversight

GPSR2. Taxes, Management Fee Increase

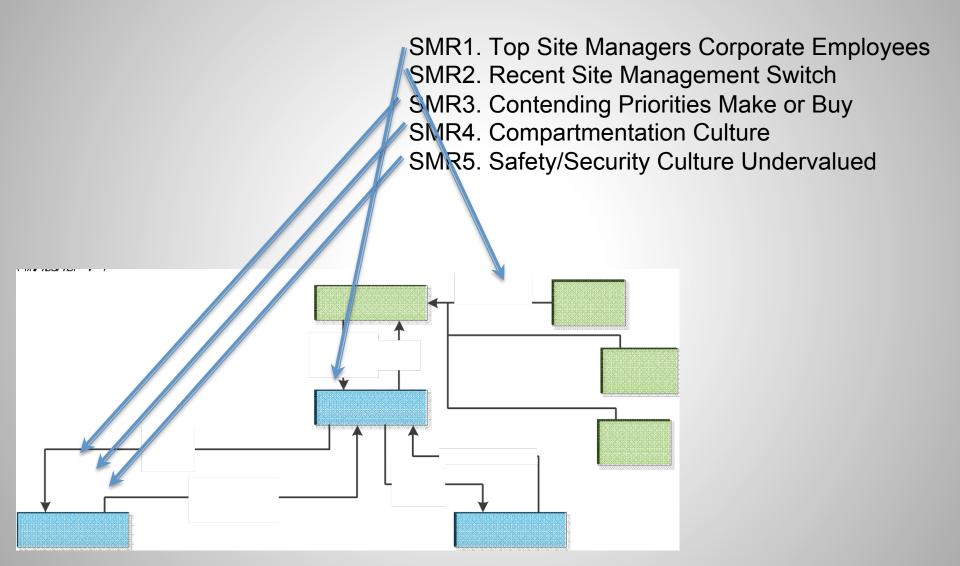
GPSR3. Work to Performance Incentives

GPSR4. Corporate Management Experience

GPSR5. Private Oversight Firm Acquired

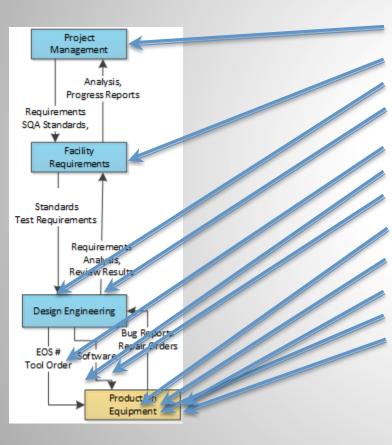
GPSR6. Lack of Production Culture

Site Management Risks





Development Risks



DR1. Wrong Compliance/Classification Standards

DR2. Requirements Unclear

DR3. Design Generation Tools

DR4. Configuration Management

DR5. Version Control

DR6. One of a Kind Development (30 Year Hiatus)

DR7. Rare Skill Mix Required, Understaffing

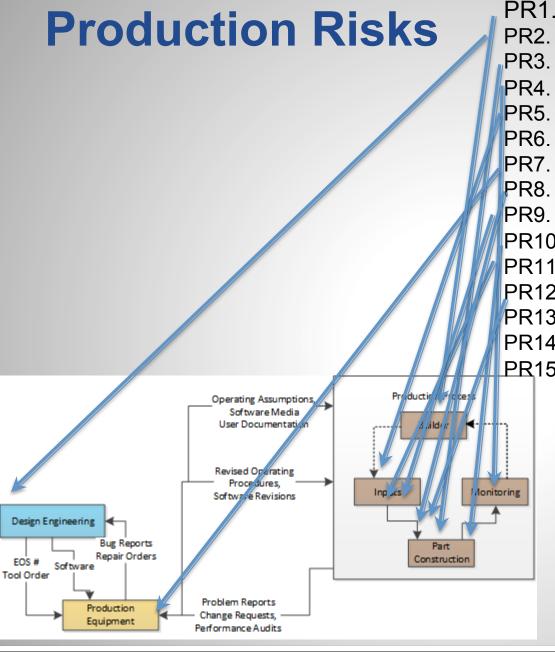
DR8. Retiring Labor Pool

DR9. Using Legacy Drawings to Build Parts

DR10. Budget and Schedule over Quality

DR11. Cyber security of Design Documentation

DR12. Difficulty in attracting talent to location



PR1. Tolerances not maintained

PR2. Drawing Correctness

PR3. Quantifying the Machines Uncertainty

PR4. Validating Results (Inspections)

PR5. Workspace Control

PR6. Lack of Independent Oversight

PR7. Repeatability of the Production Process

PR8. Welding Set Up

PR9. Retiring Production Employees

PR10. Production Culture vs. Design Culture

PR11. Spill Containment

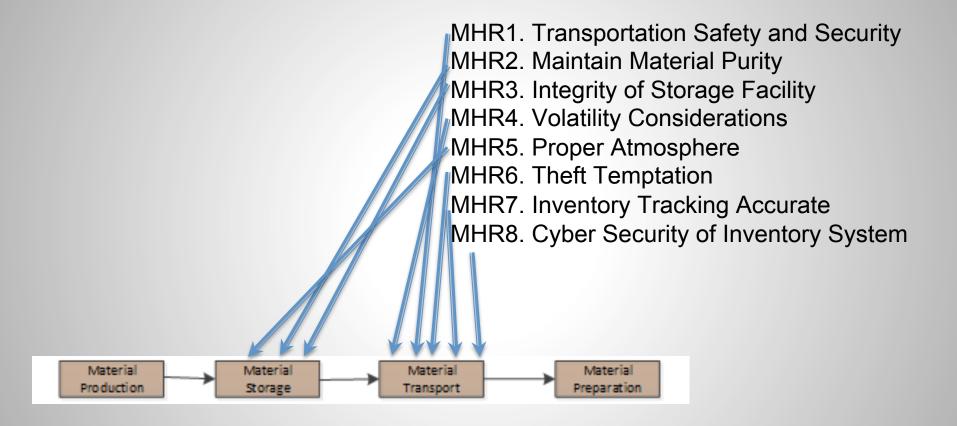
PR12. Material Handling

PR13. Blank Forming

PR14. Volatility Considerations

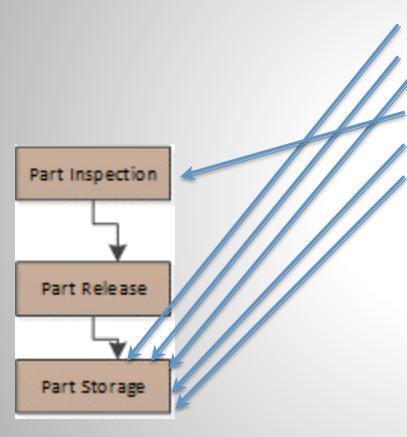
PR15. Toxic Scrap Disposition

Material Handling Risks





Post Production and Storage Risks



PPR1. Volatility Considerations

PPR2. Theft Security

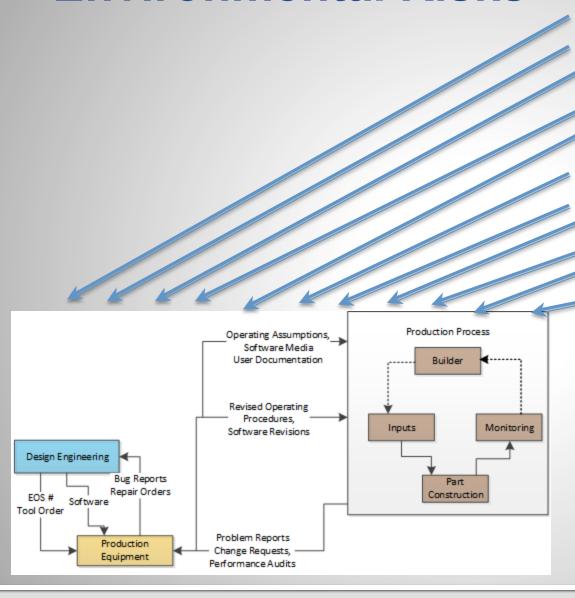
PPR3. Maintain Interior Atmosphere

PPR4. Failed Inspection Process

PPR5. Inventory Tracking Accurate

PPR6. Cyber Security of Tracking System

Environmental Risks



ER1. Earthquake

ER2. Flood

ER3. Tsunami

ER4. Hurricane

ER5. Tornado

ER6. Wild Fire

ER7. Reservoir Splushing

ER8. Volcano

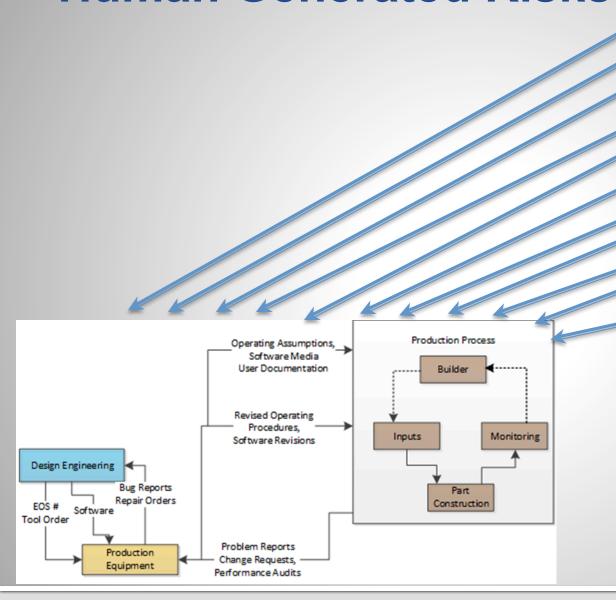
ER9. Lightning

ER10.Sinkhole

ER11 Blizzard, Ice, Hail Storm



Human Generated Risks



HGR1. Aircraft

HGR2. Armored Vehicle

HGR3. Drone

HGR4. Truck Bomb

HGR5. Tunneling

HGR6. Missile

HGR7. Biological

HGR8. Chemical

HGR9. Dirty Bomb

HGR10. Laser

HGR11. Cyber

Risk Tracker for 84 Risks

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Government Entity Risks

	1						T
GR1.	rseauestration.	Unexpected cessation of funds needed for widget production could cause shut down and start up modes that could add risk to safe operation. Also reduction in funds	Identified	4- Delay	1-Multiple	Mitigate	Assure that widget production funding is not impacted by sequestration or interruptions in funding that is political in nature.
GR2	l roalla sation	Other congressional priorities could divertfunds for widget production to other programs, reducing funding for widget production and impacting safety and schedule.	Identified	4-Delay	1-Multiple	Mitigate	Assure that widget production funding is not impacted by competing priorities or interruptions in funding that is political in nature.
GR3	II ongress/Executive	Delays caused by the slow legislative process or inability to getrequired votes to pass required legislation could encourage urrealistically short schedules to compensate	Identified	4-Delay	1-Multiple	Mitigate	Assure that legislative or executive delays do not compromise schedules required to safely produce widgets.
GR4	Congress Privatization of Site	Privatization of sites for widget production creates the possibility that executives in charge of widget production do not have experience in widget production and will	Identified	2-Employee Safety	2-Infrequent	Mitigate	Assure private corporate executives include those with widget production experience and create advisory boards made up of retired employees who have lesson learned experience from previous production efforts.
GR5	Secretary Automation Experience	Reliance on modern production automation will require oversight with experience in areas such as CAD/CAM/robotics, software, networks, CM factory automation, etc	Identified	2-Employee Safety	2-Infrequent	Mitigate	Select. Secretary oversight employees that have experience in production methods used for widget production as well as domain expertise in widgets.
GR6	Secretary/Oversite Turnover	Employees with experience in widget production are retiring or no longer living or are hard to relocate to plant site.	Identified	4-Delay	2-Infrequent	Mitigate	Interview experienced retirees and form advisory boards of experienced former employees to pass on relevant experience in widget production. Use simulation techniques to help train replacement employees.
GR7	IL IVersite Automation	Reliance on modern production automation will require oversight with experience in areas such as CAD/CAV/ robotics, software, networks, CIV/factory automation, etc.	Identified	2-Employee Safety	2-Infrequent	Mitigate	Select Oversite oversight employees that have experience in production methods used for widget production as well as domain expertise in widgets.
GR8	Oversite Budget Concerns	Funding outs to Oversite may reduce ability to conduct comprehensive hazard analysis	Identified	4-Delay	2-Infrequent	Mitigate	Assure Oversite or other agency will be supported adequately to oversee widget production.
GR9	Oversite Differing Technical Opinion With	Oversite and site may not be able to compromise on solutions and encourage lack of transparency.	Identified		1-Multiple	Mitigate	Assure Oversite oversight personnel are experienced in the areas they are assessing
GR10	Personal Oninions Over	Decisions are made based on organizational hierarchy of the decider rather than taking into account experience of lower level employees.	Identified	2-Employee Safety	1-Multiple	Mitigate	Emphasize advisory board concerns and advice when making policy, standards, budgets, schedule, or procedural decisions



Government, Privatizing, Site Risks

	Funding from Secretary,	- F F					,
GPSR1	,,	Secretary is schedule and budget driven, Oversite is safety					budgetary, schedule, or procedural decisions.
	Oversight from Oversite	driven leading to bureaucratic delays.	Identified	4 - De lay	2 - Infrequent	Mitigate	
	Taxes and Management	Corporate oversight are for profit companies and therefore					Plan for increased management fees in future budgets.
GPSR2		subject to taxes. Additional risk of widget production may					
	Fee Increase	cause increases in management fees.	Identified	4 - De lay	2 - Infrequent	Mitigate	
	Work to Performance	If management oversight is tied to performance bonuses If					Tie incentives to safe operations rather than just schedule and budget performance.
GPSR3		and this extends to widget production it could influence		2 - Employee			
	Incentives	site management to take risks to receive bonuses.	Identified	Safety	1 - Multiple	Mitigate	
	Corporate Management	Corporations that manage site may not have experience in					Assure site oversight management has experienced widget production staff.
GPSR4		widget production or a production culture.		2 - Employee			
	Experience		Identified	Safety	2 - Infrequent	Mitigate	
	Private Oversight Firm	Oversight firm could be acquired or go out of business					Stipulate that any changes in site management companies must be requalified before
GPSR5		during widget production, if acquired the new		3 - Financial			being allowed to continue.
	Acquired	management may not be experienced in widget	Identified	Loss	2 - Infrequent	Monitor	
	Lack of Production	The chosen widget production site must have experience					Assure that site management includes experienced production managers and key
GPSR6		in production and a production culture.		2 - Employee			employees with experience in products similar to widgets.
	Culture		Identified	Safety	2 - Infrequent	Mitigate	



Opposed priorities for widget production. For instance

Emphasize advisory board concerns and advice when making policy, standards,

Site Management Risks

Corporate Management experience may not be in widget

op Site Managers	production		2 - Employee			budgetary, schedule, or procedural decisions.
orporate Employees	production	Identified	Safety	2 - Infrequent	Mitigate	baugetary, suredure, or procedural decisions.
ecent Site Management	Corporate Management is new to this site.			Ì		Emphasize advisory board concerns and advice when making policy, standards,
·						budgetary, schedule, or procedural decisions.
witch		Identified	4 - Delay	2 - Infrequent	Mitigate	
ontending Priorities	Widget production equipment not available on commercial					For vendor built equipment for manufacturing assure rigorous vendor qualification
	market may require special fabrication by a vendor or					process.
ake or Buy	built by site.	Identified	4 - Delay	1 - Multiple	Mitigate	
omnartmentation	The site may have siloed departments that are not					Organize the widget production into multi-disciplined teams so that design and
·	accustomed to working together. For example design and					production can work together to optimize production.
ulture	production.	Identified	4 - Delay	2 - Infrequent	Mitigate	
fety/Security Culture	The site may not have a strong safety culture required for				_	Supply training and create processes that embrace safety as the primary priority.
. '' '	the production of widgets.		1 - Public			Emphasize advisory board concerns and advice when making policy, standards,
ndervalued		Identified	Safety	2 - Infrequent	Mitigate	budgetary, schedule, or procedural decisions.
or wi	rporate Employees cent Site Management ritch ntending Priorities ake or Buy mpartmentation lture fety/Security Culture	production. Corporate Employees Corporate Management is new to this site. Corporate Management is new to this site. Widget production equipment not available on commercial market may require special fabrication by a vendor or built by site. The site may have siloed departments that are not accustomed to working together. For example design and production. The site may not have a strong safety culture required for the production of widgets.	production. Corporate Employees Corporate Management is new to this site. Corporate Management is new to this site. Identified Widget production equipment not available on commercial market may require special fabrication by a vendor or built by site. Identified The site may have siloed departments that are not accustomed to working together. For example design and production. The site may not have a strong safety culture required for the production of widgets.	production. 2 - Employee Safety 4 - Delay 4 - Delay 2 - Employee Safety 4 - Delay 4 - Delay The site may have siloed departments that are not accustomed to working together. For example design and production. The site may not have a strong safety culture required for the production of widgets.	production. 2 - Employee Safety 2 - Infrequent Corporate Management is new to this site. Corporate Management is new to this site. Corporate Management is new to this site. Widget production equipment not available on commercial market may require special fabrication by a vendor or built by site. Identified 4 - Delay 2 - Infrequent Identified 4 - Delay 1 - Multiple The site may have siloed departments that are not accustomed to working together. For example design and production. The site may not have a strong safety culture required for the production of widgets.	production. 2- Employee Safety 2 - Infrequent Mitigate Corporate Management is new to this site. Midget production equipment not available on commercial market may require special fabrication by a vendor or built by site. Identified 4 - Delay 2 - Infrequent Mitigate Mitigate Mitigate The site may have siloed departments that are not accustomed to working together. For example design and production. The site may not have a strong safety culture required for the production of widgets.

Emphasize advisory board concerns and advice when making policy, standards,

Development Risks

4	Wrong Compliance	Existing current standards may not appropriately cover				ı	Assure that appropriate existing and legacy widget making standards and dassification
DR1		production of widgets.		3- Financial		ı	guides are followed using training along with oversight audits and assessments for
	/Classification Standards		Identified	Loss	2-Infrequent	Mitigate	compliance to the standards.
!	Í '	Lack of recent experience in widget production leads to				ı	Emphasize advisory board concerns and advice when making policy, standards,
DR2	Requirements Unclear	unclear requirements for production facility or processes				ı	budgetary, schedule, or procedural decisions.
	1	or staff.	Identified	4 - Delay	2-Infrequent	Mitigate	
	1	New tools designed for widget production do not function				ı	Plan for significant time to test and evaluate new tools prior to use in production.
DR3	Design Generation Tools	as desired.		2- Employee		ı	
	1		Identified	Safety	2-Infrequent	Mitigate	
	Configuration	Design software for new widget production tools contains					Protect design software from network intrusions, place tool design under
DR4 I		errors or security vulnerabilities.		3- Financial		ı	configuration management.
	Management	·	Identified	Loss	2-Infrequent	Mitigate	
	1	Errors or vulnerabilities in tool design software not					Assure tool software updates to fix vulnerabilities are accomplished and retest is
DR5	Version Control	updated.		2- Employee		ı	performed.
. '	1] '	Identified		2-Infrequent	Mitigate	
	One of a Kind	Tools needed for widget production may not be available					Qualify commercial tools or software for designing tools for widget production prior to
DR6		from commercial vendors.	[1	use. Limit sources of commercial tools to trusted and qualified vendors.
	Development		Identified	4 - Delay	2-Infrequent	Mitigate	
	Rare Skill Mix Required.	Skills needed to produce widgets are rare and require					Identify sources of qualified widget production skills and recruit them for widget
DR7	, , , , , , , , , , , , , , , , , , , ,	extensive training and experience.	[1	production.
	Understaffing		Identified	4 - Delay	2-Infrequent	Mitigate	
		Staff with widget production skills have retired or are					Offer incentives for retired widget production workers to re enter the work force.
DR8		retiring soon or hard to attract to location of production	[1	
		plant	Identified	4 - Delay	2-Infrequent	Mitigate	
		Legacy drawings for building widgets may contain errors or	Identified	4 000	Z- Inirequent		Allow time to make corrections or improve quality of legacy drawings for widget parts.
DR9	IIISIDD FEDACY DRAWIDDS -	be hard to interpret.				ı	Allow time to make confections of improve quality of regary drawings for imager parts.
DIG I	to Build Parts	be find to filter pret.	Identified	4 - Delay	2 - Infrequent	Mitigate	
		Pressure on production to meet schedule milestones or	Паенингеа	4 - Deray	Z- Inrequent	Willigate	Keep safety and quality as the top priority, relegating cost and schedule to secondary
DR10	I Duide at op dis abadula	1 '				ı	considerations.
	over Quality	budget constraints may create unrealistic deadlines or	Identified	4 - Delay	2-Infrequent	Mitigoto	considerations.
		resource constraints.	Identiffed	4- Бегау	2- Inirequent	Mitigate	
	I (When security of Design I	Electronic forms of design documentation susceptible to		3- Financial		ı	Assure electronic documentation is airgapped to public networks and use biometric
	Documentation	cybertheft.	Identified	Loss	2-Infrequent	Mitigoto	identification to minimize insider threat.
				LUSS	2- Inirequent	Mitigate	
	I Ditticulty in Attracting	Location may be in rural area without access to labor supply				ı	Assure electronic documentation is airgapped to public networks and use biometric
DR12		or industries needed to support needed technologies and	Instified	1 Dolay	2 Infraguent	Mitigota	identification to minimize insider threat.
	talent to location.	skills	Identified	4 - Delay	2-Infrequent	Mitigate	



Production Risks

PR1	Tolerances not maintained	Exacting tolerances for fabrication not met, such as welding tolerances.	Identified	4 - Delay	2 - Infrequent	Mitigate	Routine maintenance and periodic calibrations performed when required enforced with oversight.
PR2		Legacy drawings contain errors, are hard to read, or errors induced when updated to electronic media.	Identified	4 - Delay	2- Infrequent	Move	Verify and validate independently the original prints used against reproductions or digitization's.
PR3	Quantifying the Machines Uncertainty	Machinery used for production not able to meet required production tolerances.	Identified		2- Infrequent	Move	Independently verify machine tool tolerances meet or exceed required tolerances.
PR4	Validating Results (Inspections)	In process inspections fail to catch errors.	Identified	3 - Financial Loss	2 - Infrequent	Move	Provide independent inspections during production runs and independent sampling and test.
PR5	Workspace Control	Workspace access not restricted to qualified employees or workspace environment not conducive to worker focus.	Identified	2- Employee Safety	2 - Infrequent	Mitigate	Provide appropriate physical plant security in depth. Allow any production employee to call a stop work.
PR6	Lack of Independent Oversight	Oversight is not impartial or independent.	Identified	4 - Delay	2 - Infrequent	Move	Oversight provided by entity that is not under the influence of the production site.
PR /	Repeatability of the Production Process	Production tools wear out or tolerances drift off over time.	Identified	4 - Delay	2 - Infrequent	Move	Independently verify machine tool tolerances meet or exceed required tolerances. Replace equipment before end of life
PR8	Welding Set Up	Welding set up not done correctly causing production widgets to be defective.	Identified	4 - Delay	2 - Infrequent	Mitigate	Provide training for welders, consider some or all of the welding be done using automated techniques to improve repeatability.
PR9	Retiring Production Employees	Scarce labor pool of qualified production workers.	Identified	4 - Delay	2 - Infrequent	Mitigate	Provide salaries and benefits to attract and maintain top talent. Provide specialized training for widget welding.
PR10	Production Culture vs. Design Culture	Production and design sites not collocated or production lessons learned not able to influence design.	Identified	4 - Delay	1- Multiple	Mitigate	Collocate design and production facilities.
PR11	Spill Containment	Hazards during production of widgets are not confined to production area.	Identified		2 - Infrequent	Mitigate	Provide a work environment which contains hazardous materials or atmosphere to strictly controlled enclosures or work areas.
PR12	Material Handling	Material is damaged during handling.	Identified	4 - Delay	2- Infrequent	Mitigate	Create a production culture where reporting defects is rewarded and encouraged.
PR13	Raw Material Forming	Raw material not formed in a way that is useful for widget production.	Identified		2- Infrequent	Mitigate	Assure incoming inspection can detect defects in material form and construction.
PR14	Volatility Considerations	During production the materials become volatile.	Identified	2- Employee	2- Infrequent	Mitigate	Provide a work environment which contains hazardous materials or atmosphere to strictly controlled enclosures or work areas.
PR15	Toxic Scrap Disposition	Scrap material from production not disposed of properly.	Identified	1- Public	2- Infrequent	-	Assure inventory tracking of scrap material and safe disposal of hazardous scrap.
	<u></u> '		raciidiida	ource,	2 milegaene	ivillegate	



Material Handling Risks

MHR1	Transportation Safety and Security	Widget raw material is spilled, damaged, or stolen during transportation to production site.	Identified	1 - Public Safety	3 - Not Yet	Mitigate	Provide secure transportation and accountability for materials from departure to arrival.
MHR2	Maintain Material Purity	Widget raw material has been degraded in storage and is not suitable for widget production.	Identified	4 - Delay	3 - Not Yet	Mitigate	Provide comprehensive incoming material inspection prior to use in widget production.
MHR3	Tricognity of Storage	The widget raw material storage facility has lost or misplaced widget raw material.	Identified	1 - Public Safety	3 - Not Yet	Move	Assign to law enforcement to investigate missing raw materials
MHR4	Volatility Considerations	The widget raw material storage facility has stored raw material in a way that has allowed it to become volatile.	Identified	2 - Employee Safety	3 - Not Yet	Mitigate	Assure storage of widgets is monitored and done following a safe method.
MHR5	Proper Atmosphere	The widget raw material must be transported by a conveyance that maintains a proper environment for the	Identified	1 - Public Safety	3 - Not Yet	Mitigate	Widget materials must retain their integrity in the most severe accident conditions, including high impacts, explosion, and fire for air, land, or sea transport.
MHR6	Theft Temptation	Widget raw material is stolen during movement to production site.	Identified	1 - Public Safety	3 - Not Yet	Mitigate	Comply with transportation requirements, provide secure transportation method.
MHR7	Inventory Tracking Accurate	Widget raw material is unaccounted for, the inventory records do not agree with physical inventory.	Identified	1 - Public Safety	3 - Not Yet	Move	Employ independent audit to determine cause, involve law enforcement if appropriate.
MHR8	Cyber Security of Inventory System	The widget raw material inventory system has been compromised by a cyber security incident.	Identified	2 - Employee Safety	1 - Multiple	Mitigate	Network and software inventory control systems are air gapped to the internet and multiple authentication is required internally.

Post Production and Storage Risks

		Widgets become volatile during storage or while being					Widget quantity and packing density controlled in storage and transport.
PPR1	Volatility Considerations	transported.		1 - Public			
			Identified	Safety	1 - Multiple	Mitigate	
		Widgets are stolen during storage or transportation after					Physical plant security must control access to storage facility and provide adequate
PPR2	Theft Security	production.		1 - Public			transportation security resources.
			Identified	Safety	3 - Not Yet	Mitigate	
	Maintain Interior	Widgets damaged during storage.					Controlled storage environment must have power and other resource backup to
PPR3	Atmosphoro						maintain environment in case of power outage, act of nature, or national emergency.
	Atmosphere		Identified	4 - Delay	2 - Infrequent	Mitigate	
DDD4	i diled ilispection	Widgets that fail inspection are not disposed of or		1 - Public			Plans for safe disposal of scrap materials and / or reprocessing of materials not passing
PPR4	Process	reprocessed safely.	Identified		2 - Infrequent	Mitigate	inspections must assure public and worker safety.
	Inventory Tracking	Inventory tracking system Secretary's not include features					Assure features for safe storage and movement of finished goods are included in
PPR5		required for safe movement and storage of widgets.					tracking system.
	Accurate		Identified	4 - Delay	1 - Multiple	Mitigate	
2226	Cyber Security of	The tracking system used to keep track of widget inventory					Air gap deployed inventory tracking system to outside world. Provide inside
PPR6	Tracking System	must not be vulnerable to cyber attack.	Identified	4 - Delay	1 - Multiple	Mitigate	authentication that relies on biometric information.



Environmental Risks

ER1	Earthquake	Production facility is located on or near fault or fracking area. Large earthquake occurs. Power outage	Identified	2 - Employee Safety	2 - Infrequent	Mitigate	Production facilities located in two geographical locations, neither of which contains fault activity.
ER2	Flood	Flooding conditions occur and over whelm production facility including loss of power.	Identified	3 - Financial Loss	3 - Not Yet	Mitigate	Production facilities located in two geographical locations, neither of which contains flood activity. Locations are not in flood plain.
ER3	Tsunami	As a result of a natural event a Tsunami occurs flooding shoreline areas.	Identified	2 - Employee Safety	3 - Not Yet	Mitigate	Production facilities located in two geographical locations. Locations are near a coast al area above 250ft elevation level.
ER4	Hurricane	Hurri cane force winds are encountered at production site.	Identified	3 - Financial Loss	2 - Infrequent	Mitigate	Production facilities located in two geographical locations. Production facilities can withstand Cat 5 winds.
ER5	Tornado	Production plant is in the path of a tornado	Identified	3 - Financial Loss	2 - Infrequent	Mitigate	Production facilities located in two geographical locations. Production facilities can withstand Cat 5 winds.
ER6	Wild Fire	Production plant is in the path of a wild fire bringout of control.	Identified	3 - Financial Loss	3 - Not Yet	Mitigate	Production facilities located in two geographical locations. Production facilities not located in forested area.
ER7	Reservoir Splushing	Reservoir near production plant is spills water out due to landslide or earthquake or failed dam.	Identified	3 - Financial Loss	3 - Not Yet	Mitigate	Production facilities located in two geographical locations. Production facilities not located below elevation of reservoirs.
ER8	Volcano	Volcano is area of production plant spews ash and lava towards production plant.	Identified	3 - Financial Loss	3 - Not Yet	Mitigate	Production facilities located in two geographical locations. Production facilities not located in volcanically active area.
ER9	Thunder Storms	Lightening strike hits production plant	Identified	4 - Delay	1 - Multiple	Mitigate	Production facilities located in two geographical locations. Facilities have lightening strike protection.
ER10	Sinkhole	Sinkhole form at of near production facility	Identified	2 - Employee Safety	3 - Not Yet	Mitigate	Production facilities located in two geographical locations. Facilities not located near sinkhole activity.
ER11	Blizzards, Ice, Hail Storm	Severe snow, ice, hail occur at product plant location	Identified	4 - Delay	3 - Not Yet	Mitigate	Production facilities located in two geographical locations. Facility protected from extreme weather conditions. Power back up and life sustaining provisions provided.



Human Generated Risks

HGR1	Aircraft	Aircraft accidently or deliberately crashes into production facility. Helicopter tries to land in production facility.	Identified	2 - Employee Safety	3 - Not Yet	Mitigate	Production facility located in structure or underground that can withstand direct hit of aircraft.
HGR2	Armored Vehicle	Armored vehicle attempts to enter production facility	Identified	2 - Employee Safety	3 - Not Yet	Mitigate	Perimeter of production plant protected by crash proof barriers to keep unauthorized vehicles from gaining close proximity to plant.
HGR3	Drone	Unmanned aircraft is flown over or into production plant	Identified	2 - Employee Safety	3 - Not Yet	Mitigate	Drone detection and disabling technologies deployed at production site.
HGR4	Truck Bomb	Vehicle with large explosives is detonated at or near production plant.	Identified	2 - Employee Safety	3 - Not Yet	Mitigate	Perimeter of production plant protected by crash proof barriers to keep unauthorized vehicles from gaining close proximity to plant.
HGR5	Tunneling	A tunnel is constructed under the production plant as a way to gain entry	Identified	2 - Employee Safety	3 - Not Yet	Mitigate	Tunnel detection measures used to prevent tunnels in proximity of production plant.
HGR6	Missile	A shoul der launched or aircraft launched missile is fired at the production plant	Identified	2 - Employee Safety	3 - Not Yet	Mitigate	Production facility located in structure or underground that can withstand direct hit of missile.
HGR7	Biological	A pathogen is used to contaminate the production plant.	Identified	2 - Employee Safety	3 - Not Yet	Mitigate	Pathogen detection devices deployed at production facility.
HGR8	Chamical	A toxic chemical is used to contaminate the production plant	Identified	2 - Employee Safety	3 - Not Yet	Mitigate	Chemical warning devices deployed at production facility.
HGR9	District District	A dirty bomb releases radiation at of near the production plant	Identified	1 - Public Safety	3 - Not Yet	Mitigate	Radiation detection devices deployed at production facility.
HGR10	1	A laser device is used against the production facility to gain entry or disable surveillance cameras.	Identified	2 - Employee Safety	3 - Not Yet	Mitigate	Production facility located in structure or underground that can withstand direct hit of laser.
HGR11	C 1	Hacker is able to modify software, exploit vulnerability, find backdoor.	Identified	4 - Delay	1 - Multiple	Mitigate	All software used at plant is checked for exploitable vulnerabilities, checked against National vulnerability Database, air gapped to internet.



Example Major Risks

- PPR1 Widgets become volatile during storage or while being transported.
- PPR4 Widgets that fail inspection are not disposed of or reprocessed safely.
- MH1 -Widget raw material is spilled, damaged, or stolen during transportation to production site.
- PPR2 Widgets are stolen during storage or transportation after production.
- MH7 Widget raw material is unaccounted for, the inventory records do not agree with physical inventory.



Example Risks by Category

 GR3 - Delays caused by the slow legislative process or inability to get required votes to pass required legislation could encourage unrealistically short schedules to compensate for a late start due to legislative or executive delays.

 GPSR3 – If management oversight is tied to performance bonuses and this extends to widget production it could influence site management to take risks to receive bonuses.

Example Risk by Category

 SMR5 - The site may not have a strong safety culture required for the production of widgets.

 DR3 - New tools designed for widget production do not function as desired.

PR9 - Scarce labor pool of qualified production workers.

 MHR8 - The widget raw material inventory system has been compromised by a cyber security incident.

Example Risk by Category

 PPR1 - Widgets become volatile during storage or while being transported.

ER1 - Unmanned aircraft is flown over or into production plant.

 HGR3 - Production facility is located on or near fault or fracking area. Large earthquake occurs. Power outage.

Remaining Work

- SME review of Hierarchical Structure Chart
- SME review of identified risks
- SME review of risk magnitudes and probability of occurrence.
- SME review of mitigations.



STPA Summary

- There are hazard analysis techniques which have been successfully used in the past for making widgets.
- STPA found contemporary risks.
 - Government, Privatization, Cyber, Drones, etc.
- STPA can be combined with other types of hazard analysis.
- Widget experts were receptive to approach, no one technique can prove it considers everything.





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