

Crafting a GD&T Implementation

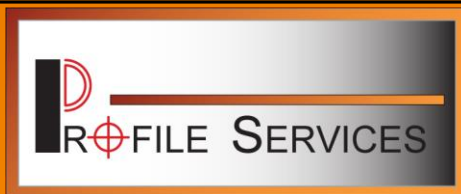


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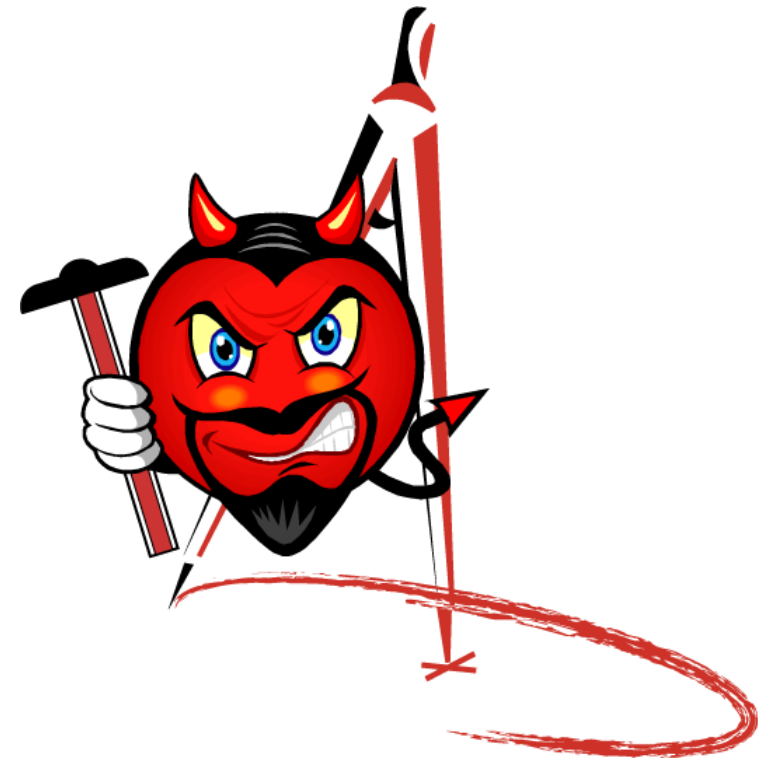


- ◆ Owner, *Profile Services*
- ◆ *GD&T Coach, Tec-Ease, Inc.*



◆ Background in

- ◆ Production Design
- ◆ Product Development
- ◆ Field Service
- ◆ Standards and Implementation
- ◆ Technology Selection



Devil's Advocate

Some definitions to start ...

GD&T

Geometric Dimensioning and Tolerancing

A mechanical engineering language composed of **12** geometric characteristic symbols, with a defined structure and syntax

Per ASME Y14.5 standard, GD&T is to convey design intent.

Some definitions to start ...

Implementation

im·ple·men·ta·tion [im-pluh-muhn-**tey**-shuhn]

noun

The act of implementing, or putting into effect; fulfillment

Crafting

kräft-ing

verb

To make or construct in a manner suggesting great care or ingenuity.

(from dictionary.reference.com)

The baseline questions

Who?

What?

When?

Where?

Why?

How?

In my own particular order.

First, Address the “Why?”

It helps to know Why you have chosen a destination before you start your journey.

Why go through the expense, stress and turmoil of a GD&T implementation?

- As part of a Lean initiative?
- To introduce SPC for quality and efficiency?
- To reduce Field Issues?
- For 100% part interchangeability?
- To produce consistently good parts?
- Reduce production, rework and scrap costs?
- It impresses industry and intimidates competitors?
- Customer requirement?
- Because someone read a magazine article about it?
- ***Any reasons missing from this list?***
- ***What is your company’s answer to ... Why?***

Second, Establish the “What?”

What do you expect to achieve?

You have a directive to implement GD&T ... but what does that entail?

- Is it a departmental, divisional or corporate undertaking?
- Is it a solo suicide mission, or a group effort?
- Education alone? Practiced skills? Functional Expertise?
- Does it involve other activities; redesigns, cost reductions, design standardizations, service resolutions?
- New product developments only, current product lines, or legacy designs?
- Geometric control applications only, TSUs, SPC and statistical controls on the drawings?
- Quality control plans, inspection report standardization, customer communications?
- *Is anything missing from this list?*
- *What is your company’s answer to ... What?*

Third ... “Who?”

Who will be involved?

How deeply ingrained do you want GD&T to be?

- Design, development, detailing?
- Process planners?
- Manufacturing personnel?
- Quality personnel
 - inspectors, CMM operators, analysts?
- Project managers / customer liaison?
- Sales team?
- Management team
 - Sales, purchasing, engineering, manufacturing?
- Suppliers
 - Design, manufacturing, quality?
- ***Who is missing from this list?***
- ***What is your company's answer to ... Who?***



Fourth ... “When?”

When must this be completed?

Time, not timing, is critical.

- Is there a particular urgency that needs to be addressed?
- Is there a status/image aspect to the timeline?
- Have adequate resources been committed
 - \$, personnel, training, equipment, space?
- Are there milestones that must be included in the implementation plan?
- Has the project been thought through and a reasonable timeline developed, including buffer time?
- Has team development time been included?
- Does this affect the position requirements and therefore long-term career planning of various personnel?
- *Has adequate time been provided to allow success?*
- *Has adequate time been provided to ensure success?*

Fifth ... “How?”

How will you achieve the implementation goal?

Full engagement of all parties.

Management must endorse the project, support the project, champion the project, and enable the project.

- Endorsing is easy ... it’s a rubber stamp and a head nod.
- Support is fairly easy ... it’s following up on commitments.
- Championing can be challenging ... you have to be genuinely enthusiastic.
- Enabling is the greatest hurdle ... you have to trust the team and ensure they have everything they need to succeed.

- *Where does your company sit for each of these?*
- *Are they enablers of technology?*

Sixth ... “Where?”

Where can you find help?

GD&T

- ⊕ Training
- ⊕ Mentoring
- ⊕ Implementation
- ⊕ Audits



- ⊕ Fundamentals
- ⊕ Applications
- ⊕ TSUs
- ⊕ Inspection

- ⊕ Focusing the skill sets for Key Users
- ⊕ Walk thru datum selection and control application

- ⊕ Help structure your implementation plan

- ⊕ Review your current GD&T practices and monitor progress

Implementation Plan

An implementation plan is a management tool for a specific technology, designed to assist companies manage and monitor the evolution of the project as the technology is integrated into the organization.

GD&T Implementation

Planning Terminology

Benefit the measurable improvement gained by one or more stakeholders.

- For GD&T, this may include better assembly fit-ups, decreased scrap, better control over manufacturing processes, reduction of inspection costs,

*Note: not all outcomes will be perceived as positive, and outcomes that are positive for some stakeholders will be negative for others (sometimes referred to as “**dis-benefits**”). (e.g. as quality improves, the service department may reduce personnel)*

Governance structure the management groups, boards and committees, and individual roles that will lead, plan, manage and validate implementation.

- Includes responsibilities, accountability hierarchy and reporting.

Management Control the approaches and methodologies used to plan and control the implementation.

Implementation Plan Components

1. Project Management

1. Management Capability Requirements

2. Governance Independence and Accountability

1. Independence
2. Roles and Responsibilities

3. Planning

1. Establish Goal
2. Benefits
3. Deliverables
4. Scheduling

4. Resource Management

1. Required Expertise
2. Business Case
3. Resource Types

5. Risk Management

1. Considerations
2. Identification
3. Mitigation

6. Stakeholder Engagement

1. Identification
2. Engagement and Communication Plan

7. Review, Monitoring and Evaluation

1. Context
2. Considerations
3. Control Variables


Implementation Plan Components

1. Management Control and Project Management

1. Management Capability Requirements

- Project management
- Personnel leadership
- Resource planning
- Design experience
- Manufacturing knowledge
- Metrology and gauging knowledge
- Risk management knowledge
- GD&T expertise (GDTP-S)

Implementation Plan Components

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Reference: Guide to Implementation Planning, Government of Australia

Implementation Plan Components

2. Governance Independence and Accountability

1. Independence

- Implementation governance team must be independent from normal production and management structures for the duration of the project

Note: An *independent* governance team, separate from the normal production and management structures, will preserve project momentum as resources cannot be subordinated to “fire fighting” duties.

Implementation Plan Components

2. Governance Independence and Accountability

2. Accountability, Roles and Responsibilities

- Project leader is accountable to one upper management project champion (individual or group), with the project champion responsible for overall direction of project and controlling communication to stakeholders outside of the implementation team
- Project champion must have expertise and independence needed for objective direction and advice
- Define a clear and effective management structure for the planning and implementation
- Define roles: responsibilities, communication hierarchy and accountabilities

Implementation Plan Components

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Implementation Plan Components

3. Planning

1. Establish Goal(s)

Goals are the expected outcomes of an implementation.

Clearly define the desired **compelling** future state

- Indicate expected changes for each stakeholder group
(include positive and perceived-negative aspects)
- Be concise and memorable

Implementations are change management. ***Resistance is inevitable if those affected do not know, understand or support the goals.***

Implementation Plan Components

3. Planning

2. Benefits

Goals communicate the intended changes.

Goals may include quantitative and qualitative aspects.

Quantitative

- 15% average cost reduction
- Defined inspection rate
(100% inspection for 13% of products
and 25 key attributes on every 3rd
workpiece)

Qualitative

- Improved skillsets and morale in
manufacturing
 - Customer perception of quality
-

Indicate how stakeholders will experience the benefits going forward, and what challenges they may face as well.

Remember: Implementations are change management. ***Resistance is inevitable if those affected do not know or understand the goals.***

Implementation Plan Components

3. Planning

2. Benefits (continued)

Include:

- Intended beneficiaries, noting assumptions, constraints and exclusions
- How the benefits realized will be delivered and monitored
- Benefits should be:
 - Specific and Agreed Upon
 - Measurable
 - Achievable
 - Relevant
 - Timelined
- Performance measures should be:
 - Focused on team's goals
 - Appropriate and useful to those using the metrics
 - Robust, with data defined and collected consistently
 - Integrated into quality management processes

Implementation Plan Components

3. Planning

3. Deliverables

- Measurable, tangible outputs that must be present to complete a project or part thereof
- List milestones for each deliverable
- Include resource requirements to attain each deliverable
- Explain activities to be undertaken to deliver the project
- Explain what activities will **NOT** be undertaken as part of the project
- Discuss related activities which are **NOT** the responsibility of the Implementation Team, and will have to have external resource commitments

Implementation Plan Components

3. Planning

4. Scheduling

- Clearly outline timeline for milestones, phases and goals
- Determines and defines a logical sequence of events constituting the major phases of work undertaken to achieve goals
- Visually pulls together related activities, tasks, deliverables, responsibilities and timeline
- Identifies bottle-necks and dependencies, and indicates resource demand

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Implementation Plan Components

4. Resource Management

Balancing the supply and demand of constrained resources.

1. Required Expertise

Implementation teams must have the appropriate skills to deliver.

- Understand the staffing requirements, skills and numbers
- Document the skillsets available in the team (skills register)
- Ensure high-priority activities have needed resources
- Where skill-gaps exist, develop or procure skillsets
(include these skillset gaps in the Risks section)

Implementation Plan Components

4. Resource Management

2. Business Case

Management likes to see numbers, specifically **\$Black** and **\$Red**.

GD&T is hard to quantify based on dollar metrics because most companies don't have a grip on the source of their quality issues, therefore can't appropriately allocate costs to causes.

To quantify how much scrap can be directly attributed to the absence of GD&T, you have to be able to inspect a part ... USING GD&T.

To quantify process capabilities, you have to be able to inspect a part ... USING GD&T.

To quantify the cost of bad- GD&T, you have to be able to inspect a part ... USING GD&T.

Implementation Plan Components

4. Resource Management

3. Resource Types

- **Human resources**
 - Leadership
 - Representatives from invested groups
 - Subject Matter Experts (SMEs)
 - Support teams
- **Office space and furniture/equipment**
- **Technology access**
 - Manufacturing
 - Quality / metrology
 - suppliers
- **Funding**
 - Salaries & Consultants
 - Travel
 - Resource materials
 - Training
 - *... for Project life duration*

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Implementation Plan Components

5. Risk Management

Risks: Uncertain event(s) which may have an effect on achieving goals.

1. Considerations

- **Issues** are unplanned events that have happened, which are affecting the project, and need to be addressed
- **Risks** that become reality become issues
- **Risks** can be
 - a **threat** (i.e. has a negative effect)
 - an **opportunity** (i.e. has a positive effect)

Implementation Plan Components

5. Risk Management

2. Identification

- **Strategic** risks from factors outside the program
- **Operational** risks related to resistance to the program
- Current and known constraints, assumptions or conflicts
- Risks may arise from:
 - Environmental changes and new developments
 - Project evolution
 - Scope creep
 - Stakeholder input
- Identify risks thru:
 - Stakeholder input
 - Review of historical or related projects
 - Consultation with SMEs for GD&T Implementations

Implementation Plan Components

5. Risk Management

3. Mitigation

- **Identify** and **Document** risks
- **Address** each risk, with
 - possible means of avoiding / eliminating risk
 - potential outcomes if left unchecked
 - course of action, and expected resolution if encountered
- Continually **Review and Update** the identified risks

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Implementation Plan Components

6. Stakeholder Engagement

Stakeholder Individual or group that has a vested interest in the program's outcome, benefits or changes, as well as those who can influence the project.

Stakeholder Engagement Process of identifying and effectively communicating with stakeholders.

1. Identification

Depending on the scope of the implementation, the following **groups** may be involved: *(partial list only)*

- Engineering / Design / Drafting (including contractors)
- Manufacturing
 - Manufacturing engineering
 - Internal machining and fabrication
 - External suppliers
- Quality
 - Gage designers
 - Inspectors
 - Machinists
- Customers
- Management



Implementation Plan Components

6. Stakeholder Engagement

1. Identification (continued)

Get specific group representatives: *(partial list only)*

- Engineering / Design / Drafting (including contractors)
 - Engineering manager, team leader
 - Senior engineers
 - Product development manager
- Manufacturing
 - Manufacturing engineering manager
 - Internal machining and fabrication team leaders
 - Senior machinists
 - External supplier managers
- Quality
 - Gage designers
 - Inspectors for open setup
 - Coordinate measurement programmers and operators
 - Quality analysts
- Customers – person(s) with responsibility for originating design and for part acceptance
- Management – person(s) who control the purse strings and resources

Organize the list of stakeholders based on ability to influence outcomes, shared interests, etc.

Implementation Plan Components

6. Stakeholder Engagement

2. Engagement and Communication Plan

describes what will be communicated, to whom, by whom, and how it will be communicated during the program.

Stakeholders become engaged when controlled, bi-direction communication is established.

What is the **purpose** of each communication?

- **Relationship** building?
- **Goal** dissemination?
- **Soliciting** input or comments?
- **Forwarding** information?
- **Establishing** a paper trail?
- **Reflecting** their position or perspective?
- **Building** consensus?

What **commitment / input** do you seek? What **message** do you want to leave?

What **nature** and **level** of contact is appropriate?

Direct or **Indirect** communication is appropriate? **Blitz** campaign?

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Implementation Plan Components

7. Review, Monitoring and Evaluation

Success of the Implementation will be evaluated based on the realized benefits to the stakeholders separately and to the organization overall.

1. Context

Stakeholder Evaluations begin well before change is introduced into the production stream.

- Progress towards first stages of roll-out will be monitored by stakeholders in anticipation ... of success or of failure.
- Recognizing this reality and preparing effective communications in the early stages will reinforce realistic expectations and gain favorable visibility.
- Stakeholders will consider the project a success or failure based on their agreed-upon criteria; ***ensure that that criteria is communicated repeatedly*** so that all expectations are fully understood.

Implementation Plan Components

7. Review, Monitoring and Evaluation

2. Considerations

- Identify who is accountable for the realization of benefits?
 - Is it an implementation team resource, or external to the group?
 - Is it someone outside of the organization?
- Be aware that milestones focus on outcomes and benefits; these ***individual outcomes have a cumulative effect as well.***
- Design an evaluation methodology up front, and ensure that it is followed.
- Reviews, monitoring and evaluations will happen during the process; schedule them in to control the timing and gain maximum feedback value.
- Recognize that monitoring and evaluation activities may have costs associated with them should be identified up front so that they do not provide a “sour note” to an otherwise successful project.

Implementation Plan Components

7. Review, Monitoring and Evaluation

3. Control Variables

GD&T Implementation timelines must be, to some degree, flexible. It is impossible for planners to anticipate every possible risk; project leaders try for certainty while minimizing ambiguity within the project plan.

Control and monitoring of these variables should be included in the implementation plan:

- Time – what is the tolerance on target dates?
- Cost – how much flexibility is there in the budget?
- Quality – how much deviation is acceptable?
- Scope – how much scope creep / reduction is acceptable?
- Risk – can resources and controls mitigate risks?
- Benefit – is there latitude on the quantifiable and qualitative?

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Crafting a GD&T Implementation

requires flexibility, adaptability, foresight and hindsight.

With some luck and a lot of work, your implementation will be successful.