Lean Product Development Flow

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Huge Productivity Reserves in PD

- Waste in PD is huge: 60-90% is routine
- Well-studied, well-known to employees
- The waste offers a **huge untapped reserve of productivity**
- LPDF is a process intended to provide:
  - **value** = non-negotiable Product Success and stakeholder satisfaction
  - while cutting schedule and cost, by removing **waste**

Why is there so much waste in PD?

- The Root Cause: PD is still executed as a "craft", as manufacturing was 100 years ago, suffering from:
  - Poor planning of task precedence
  - Lack of understanding that Lean applies to one-off
  - Ad hoc, unstable processes, outcomes
  - Poor execution, poor coordination, poor communication
  - Confused about Research versus Development versus Design
  - Dissolved PD management
  - Engineering education, tradition, tenure favor analysis over process thinking

Ohno's Seven Categories of PD Waste [LAI]

(all dealing with information)

1. **Over-production**
2. **Inventory**
3. **Transportation**
4. **Unnecessary movement**
5. **Waiting**
6. **Defects**
7. **Over-processing**

Classical symptoms of the Crafts approach.

WASTE	DESCRIPTION
1 Overproduction	• Creating unnecessary information • Performing work which is not needed • Creating documents that nobody requested • Pushing rather than pulling data • Over dissemination • Too much detail • Sending a volume when a single number was requested • Reinventing the wheel, needlessly repetitive development • Useless data, meetings • Ignored expertise • Discarded knowledge (layoffs!) • Measuring waste in some Six Sigma projects • CMMI

WASTE	DESCRIPTION
2. Transportation	• Inefficient transmittal of information • Communication failure: lost data, wrong format, information incompatibility, misunderstandings • Transportation for approvals • Multiple sources or destinations • Security issues • Distributed facilities
3. Waiting (30% of design charged time) 63% of all tasks idle at any given time)	• Waiting for data, test result, information, decision, signature.. • Late delivery • Poor scheduling, precedence, and coordination • Ignored expertise • Disorganization, reorganization

WASTE	DESCRIPTION
4. Over Processing	• Working more than necessary to produce the outcome • Point design used too early, causing massive iterations • Starting with small margins • Unnecessary serial effort • Uncontrolled iterations (too many tasks iterated) • Work on a wrong release (information churning) • Data conversions • Answering wrong questions • Many of contractual obligations (e.g., 2D drawings) • Unclear requirements or too many detailed requirements • Complex software monuments (using PRO ENGINEER or NASTRAN where a spreadsheet would do)

WASTE	DESCRIPTION
5. Inventory	• Keeping more information than needed • Poor configuration management and complicated retrieval • Poor 5 S's in factory or office
6. Unnecessary movement	• People having to move to access information • Manual intervention to compensate for the lack of process • Hand-offs
7. Defects	• Insufficient quality of information • The killer “re’s”: Readjust, Reprocess, Reapply, Reprogram, Recalibrate, Rerun, Recertify, Reschedule, Recheck, Recondition, Reship, Restock, Retest, Re-inspect, Return, Re-measure, Rewire, Reorder, Rework • Incomplete, ambiguous or inaccurate information

What to do about the waste?
Proposing Lean Product Development Flow (LPDF)

- From manufacturing Craft to Lean: throughput time, cost and inventory cut 90%, space 50%, higher quality
- LPDF is a reformulation of PD from Craft to Lean, using the same Lean Principles, also aiming for dramatic savings
- Qualifying criterion for PD: detailed high-fidelity VSM can be formulated

LPDF Formulated Using Six Lean Principles

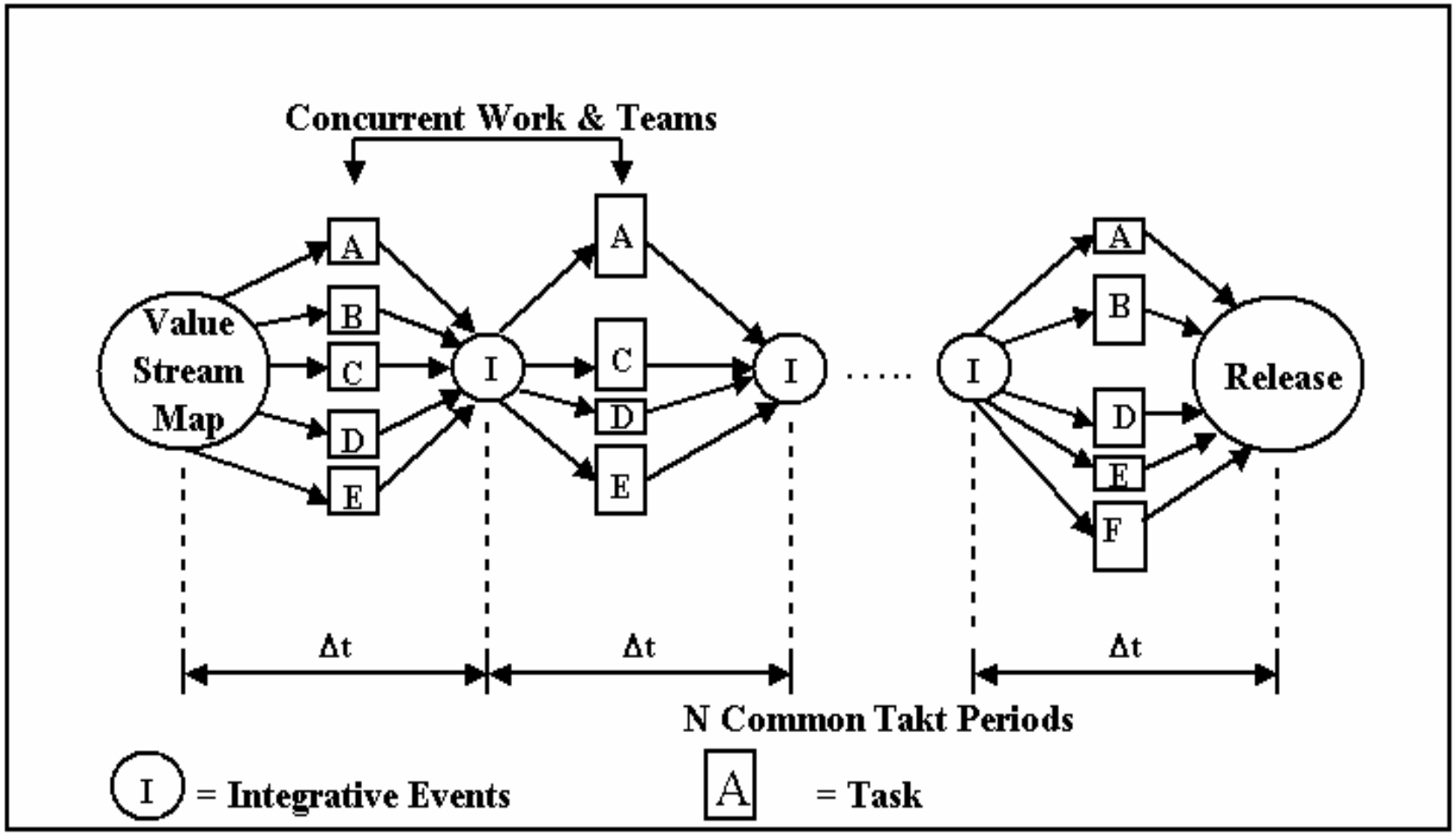
1. **Value**
   - Non-negotiable life-cycle Product Success
   - Reduced cost and schedule by reducing huge waste
   - Satisfaction of stakeholders
   - The feeling of sense and enjoyment of work
2. **VSM**
   - Detailed legacy-based VSM parsed into short Takt Periods (5 phases)
   - Just like the balanced moving line
3. **Flow =** Stable flow of information through a sequence of Takt Periods and Integrative Events
4. **Pull**
   - A Task specified only if someone needs the outcome
   - Creators to understand the needs of Internal Customers
5. **Perfection**
   - Make all imperfections visible to all. Then use continuous improvement.
6. **Respect for People**

Lean Principle 2: VSM

- **Key to a successful flow on a manufacturing moving line**
  - The ability to split and balance total work among the workers/processes of equal duration, so that it can proceed without rework or backflow
  - VSM = detailed line design
  - Requires perfecting each process and training

- **Key to successful flow in LPDF**
  - The ability to split PD into short value-adding tasks of equal duration, for subsequent flow without rework or backflow, as on a moving line
  - The task parsing can be logical, reporting, or absolute
  - VSM = detailed PD planning

Schematics of Lean Product Development Flow



Lean Principle 3: Flow

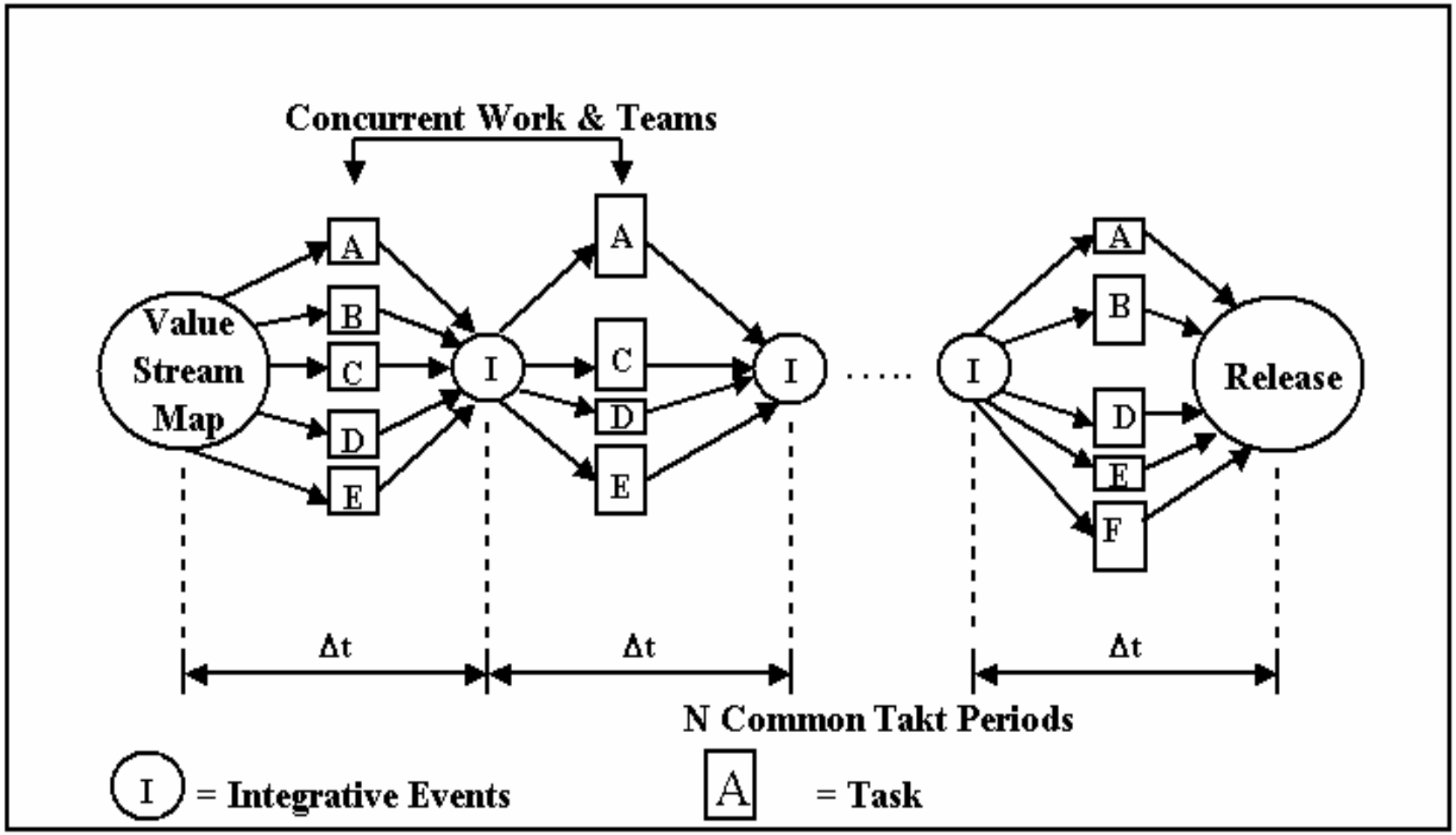
Takt Periods and Integrative Events

- Tasks performed by suitable teams, departments, individuals
- Non-negotiable Task deadlines
- Tasks of equal duration but variable effort, as needed
- Common natural frequent rhythm for everybody
- Recommend: work M-Th, Integrative Event on Friday
- Predictable “moving line” flow, discipline, efficiency
- Integrative Events = structured communications. Common frequent opportunities to integrate work, coordinate, identify and resolve issues, changes, manage uncertainties and respond flexibly, build consensus, adjust tasks, give assignments
- Participants: Core Team + help + major suppliers and stakeholders, led by the Chief Engineer

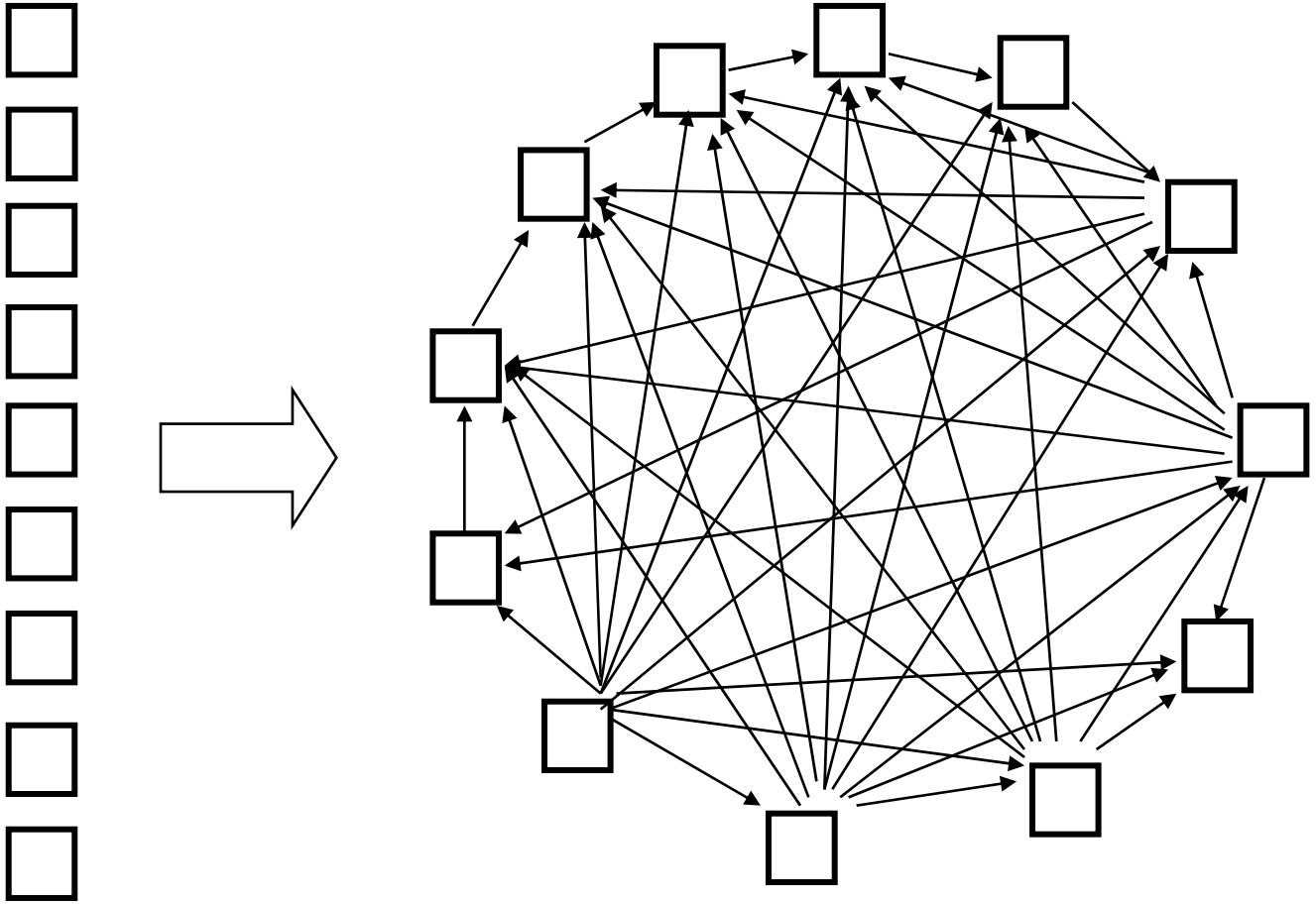
Communications

- Looking at PD Waste – a lot can be traced to inadequate communications
- Current communication culture:
  - Top-down “orders”, no brainstorming, poor teaming
  - Avoiding human contact
  - Escape into automation (software, electronic forms, requirements, email...)
- LPDF vastly elevates good leadership and communications

Formal structured Communications During Integrative Events



Informal Communications as needed during Takt Periods (never enough!)



Lean Principle 3: Flow

The practices which enable the flow and reduce waste

- Discipline of the common rhythm of deadlines for the entire team
- Comprehensive frequent periodic coordination (never enough)
- Comprehensive early identification and mitigation of risks, issues
- Dynamic allocation of resources
- Some engineers to stay for the program duration, but well-defined tasks should be staffed dynamically, from the matrix
- Exploration of design spaces, set based designs
- Addressing tradeoffs early: old/new, margins/labor cost, test/cost...
- Separation of Research, Development, Design
- Optimization of required iterations
- Building consensus in the Core Team

Leadership of Chief Engineer

- "Most coveted job in the corporation"
- Job description: "Create PD Value within budget and schedule"
- Experienced, competent leader totally responsible for the entire PD (concepts, tradeoffs, key design decisions, coordination, targets, schedule, and budget)
- Combining Toyota Chief's model:
  - Small staff, free of administration burden
  - Technical focus, expert in SE, interfaces & tradeoffs
  - Expert in human skills, consensus building, and company culture
  - Mentality of "Stopping the line if imperfect"
- with Clark's Heavyweight Technical Project Manager (obsession with product integrity, design goals, and good engineering practices)
- 2-3 dedicated Assistant Chiefs to complement the Chief's expertise & legacy knowledge
- Co-located PM to focus on RNVA: customer, budget, government and corporate controls

Conclusions

- LPDF carries **no risk** and is based on common sense
- LPDF makes the program execution totally transparent and self-monitoring, delivering value while reducing waste
- LPDF requires comprehensive planning (VSM) and disciplined execution, like a Toyota moving line
- Requires training, leadership; conducive to excellent preparation and execution