Scheduling, Fast and Slow

Know Your Scheduling Algorithm

The GPM and CPM Schemes of Thought*

- While CPM (critical path method) and GPM (graphical path method) rely on activity-logic networks, and their kinship is undeniable

  – CPM is an early-date biased, early and late dates calculator— from which total floats are derived

  – GPM is a planned-date biased, gap/drift/float calculator—from which total floats and early and late dates are derived

- This difference in how CPM and GPM algorithms makes a huge difference in scheduling cognition

GPM Schedule Analysis

- This presentation is about the exercise of intuitive and deliberate thinking that naturally flow when schedulers engage in schedule analysis (whether with GPM or CPM)

    - In particular, I intend to show that what stakeholders see on a GPM canvas innately enhances both intuitive and deliberate choices and judgments in ways that CPM simply cannot

    - The notions of intuitive thinking and deliberative thinking in mental effort are extensively covered in Thinking, Fast and Slow by Daniel Kahneman © 2011, and reinforced in Incognito the Secret Lives of the Brain by David Eagleman © 2011 and other texts

Kahneman Describes Mental Life by the Metaphor of 2 Agents: System 1 and System 2*
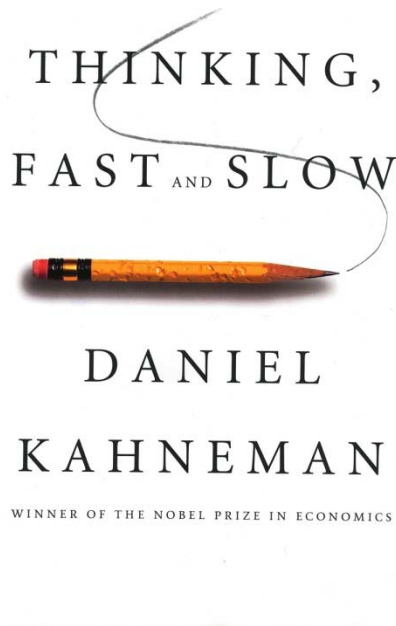
- ## System 1 produces fast thinking
  - Intuitive thought
  - More influential than experience tells you
  - The secret author of many of the choices and judgments we make
- ## System 2 produces slow thinking
  - Deliberate thought
  - Influenced by System 1
  - Uncomfortable and naturally lazy

THINKING, FAST AND SLOW

DANIEL KAHNEMAN

WINNER OF THE NOBEL PRIZE IN ECONOMICS

Kahneman's Ideas are Relevant to Scheduling Practitioners Because:

- Schedule analysis is mental work done through System 1 or System 2 depending on the information available relative to the hoped-for outcome

  – CPM analysis that necessarily engages System 2 because of how information is displayed—or not— may be readily accomplished in GPM analysis through System 1 thinking

- Whereas GPM engenders 'cognitive ease' CPM causes 'cognitive strain'

- Creativity—think problem solving—is optimized when thinking intuitively in cognitive-ease

Kahneman's Research on Fast and Slow Thinking

- Fast or System 1 thinking operates automatically and quickly, with little or no effort and no sense of voluntary control

- Slow or System 2 thinking allocates attention to the effortful mental activities that demand it, including complex computations

  – The operations of System 2 are often associated with the subjective experience of agency, choice and concentration.
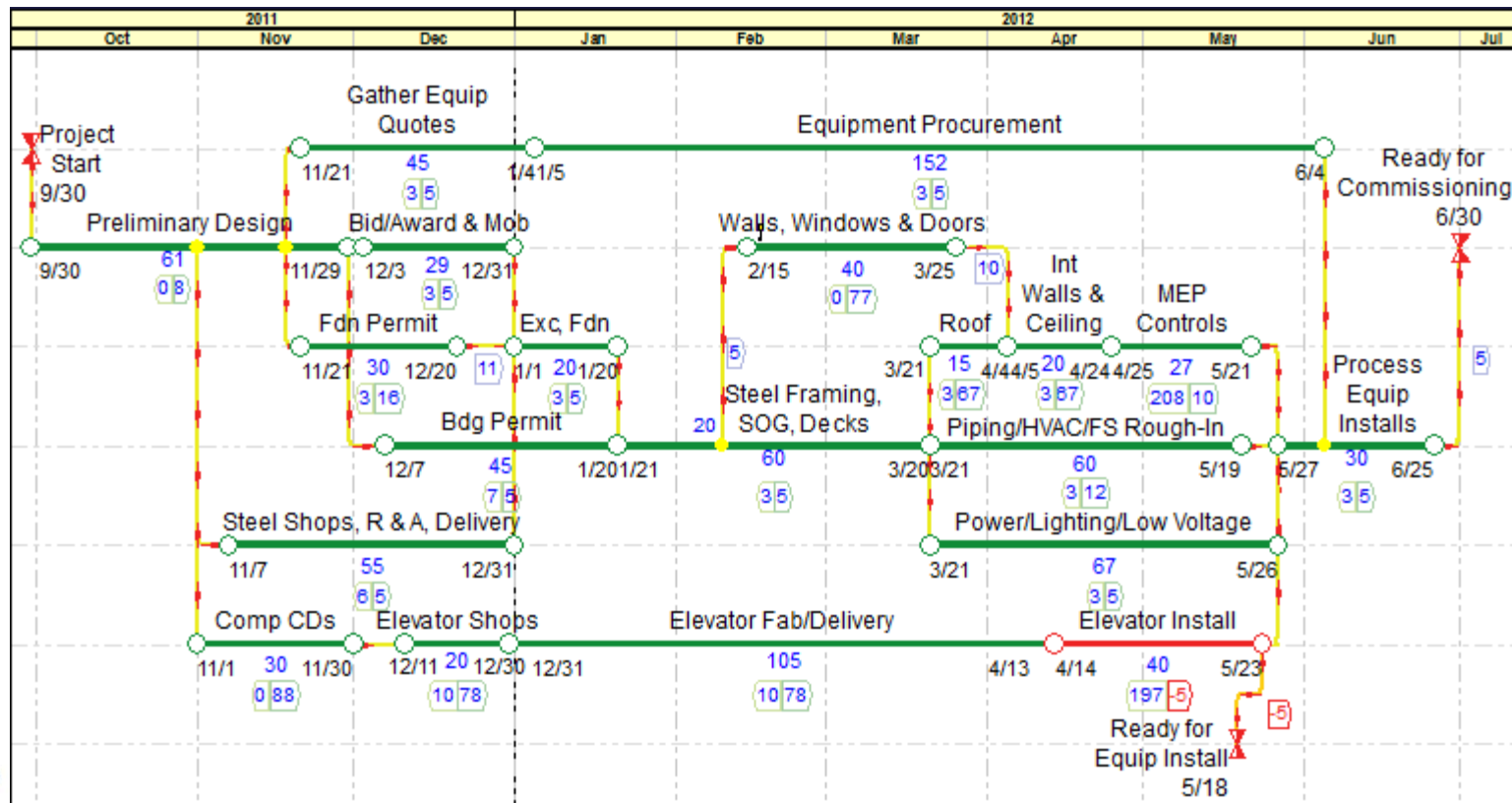
To Observe Your Mind in Deliberate Mode, Consider the Following Two Questions

- 17 x 24 = ?
- Total float of critical path to Ready for Commissioning = ?
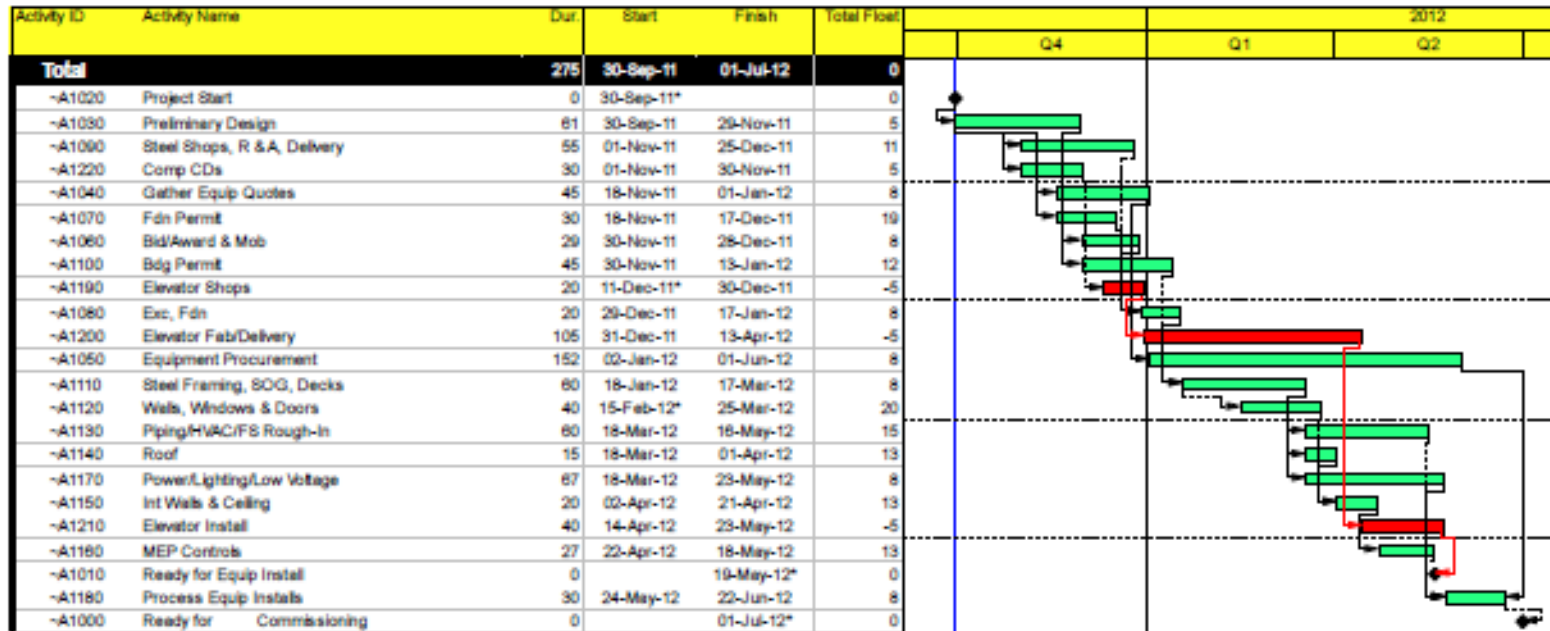
Now, to Observe Your Mind in Automatic Mode, Consider the Following Questions

- Answer 2 + 2 = ?

- Total float of the critical path to *Ready for Commissioning* = ?

Examples of System 1 in Action in Daily Life*

- Answer 2 + 2 = ?

- Complete the phrase "bread and …"

- Detect hostility in a voice

- Drive a car on an empty road

- Find a strong move in chess (if you are a chess master) are you sure about this one?

- Switch lanes while driving

- Michael Jordan hitting a three-pointer

Cases of System 1 in Action in GPM Analysis

1. Whether the schedule supports early, on time, or late completion
2. Whether a particular activity has a loose end (e.g., no predecessor)
3. Whether a particular activity has a dangling end
4. Whether a particular activity early start is driven by a planned date or an SNE constraint
5. Whether a particular activity is on the critical path (to a benchmark or the project completion milestone)
6. Whether a logic tie is a driving relationship relative to a successor
7. Whether a particular activity should be split to restore float lost by SS/FF logic
8. Whether a particular activity can drift back during resource leveling or schedule acceleration

System 1 in GPM Analysis—A Demonstrative
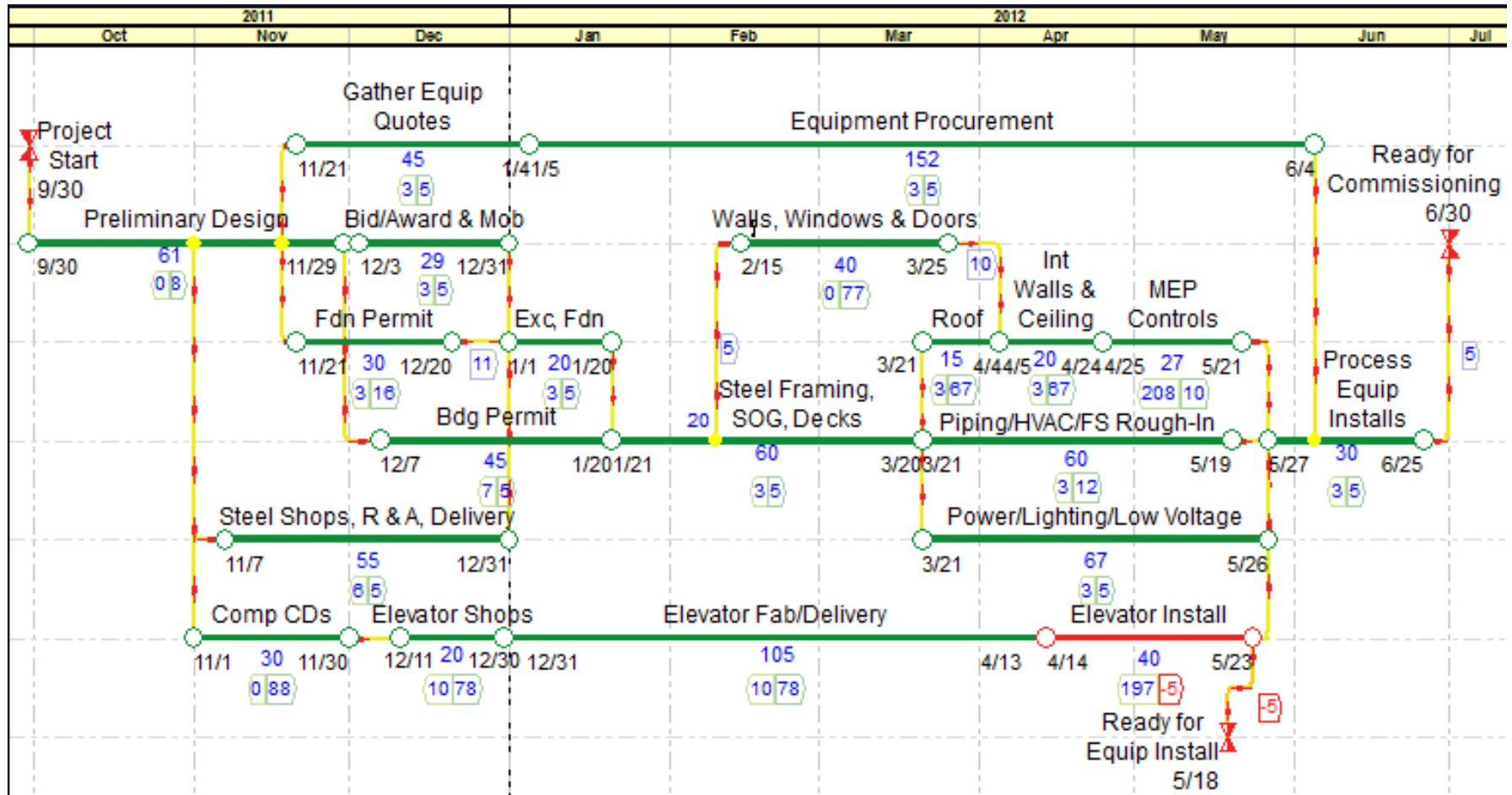
Examples of System 2 in Action in Daily Life

- Answer 17 x 24 = ?

- Maintain a faster walking speed than is natural

- Learn how to ride a bicycle

- Brace for the starter gun in a race

- Count the occurrences of the letter A in a page of text

- Compare two microwave ovens for overall value

- Fill out a tax form

- Check the validity of a complex logical argument

Cases of System 2 in Action in GPM Analysis*

- Verify that the scope associated with the project is included
- Determine how weather impacts are accounted for and if they are accurate
- Identify relationships that have negative lags
- Identify and eliminate redundant logic ties
- Determine whether a logic tie is preferential
- Determine the source of embedded negative total float
- Options available to correct resource over-demand
- How to shorten or extend a schedule optimally

Mental Effort

- The defining feature of System 2 is that its operations are effortful

  – Characterized by laziness

  – A reluctance to invest more effort than is strictly necessary

- The thoughts and actions the System 2 believes it has chosen are often guided by System 1

- However, there are vital tasks that only System 2 can perform because they require effort and acts of self control in which the intuitions and impulses of System 1 are overcome

System 1 Thinking is Rooted in Knowledges or Skills Etched in our Unconscious Mind

- As you become skilled in a task, its demand for energy diminishes
  - Studies of the brain have shown that the pattern of activity associated with an action changes as skill increases, with fewer brain regions involved
  - The "law of least effort" asserts that if there are several ways of achieving the same goal, people will eventually gravitate to the least demanding course of action

- Because we are mobile creatures that run on 'batteries,' energy saving is of the highest importance
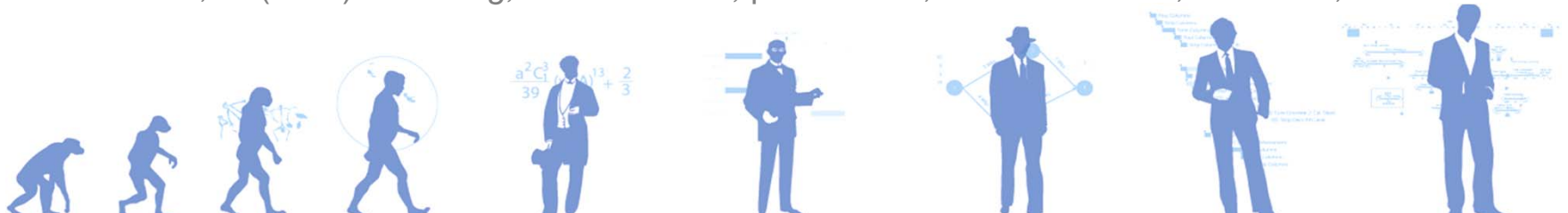
System 2 is Rooted in Your Conscious Mind*

- Effort is required to maintain simultaneously in memory several ideas that require separate actions, or that need to be combined according to a rule

  – System 2 alone can follow rules
  – System 2 alone can compare objects on several attributes
  – System 2 alone makes deliberate choices between objects or actions to be taken
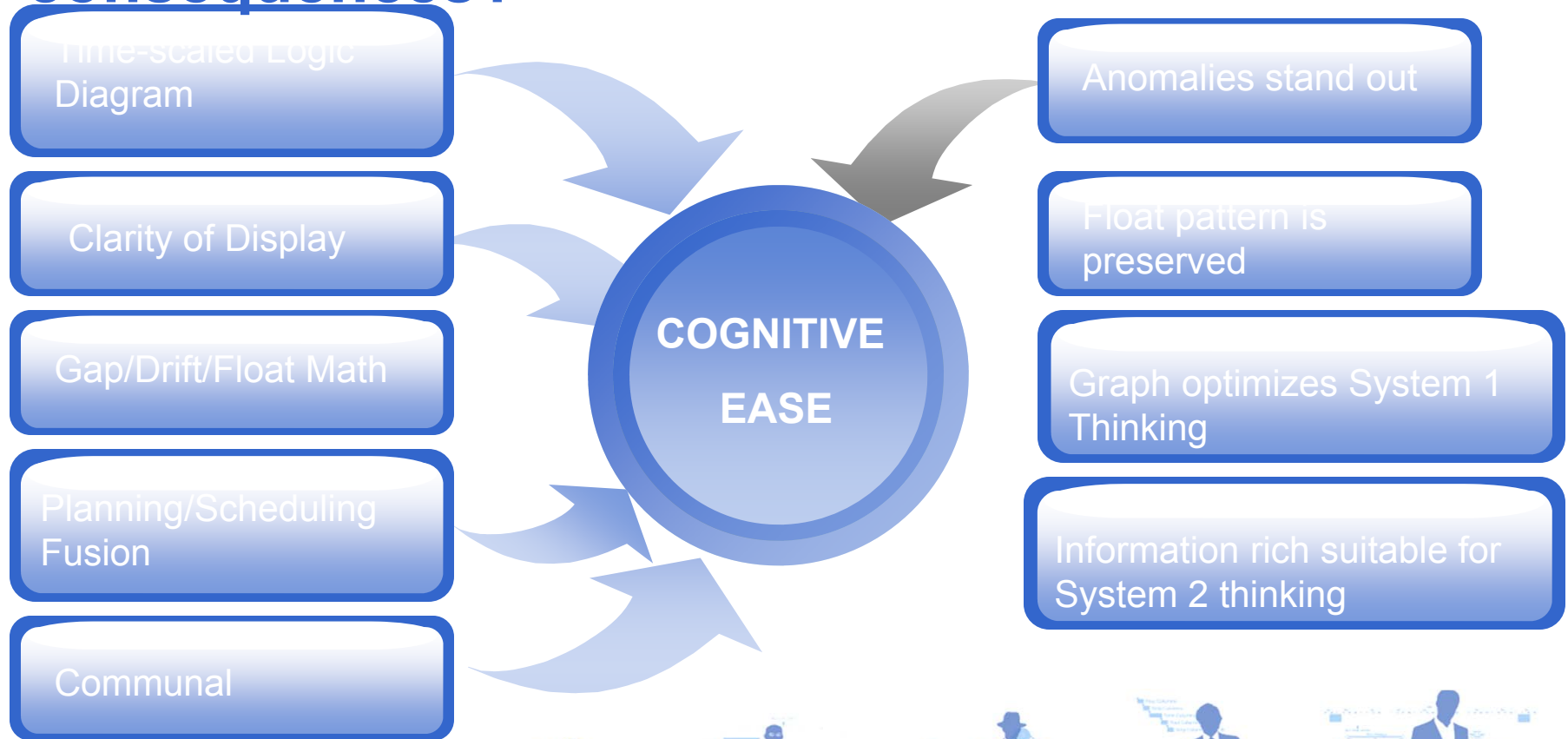
Time Pressure is a Driver of Effort

"Like a juggler with several balls in the air, you cannot afford to slow down; the rate at which material decays in memory forces the pace, driving you to refresh and rehearse information before it is lost. Any task that requires you to keep several ideas in mind at the same time has the same hurried character. Unless you have the good fortune of a capacious working memory, you may be forced to work uncomfortably hard. The most effortful forms of slow thinking are those that require you to think fast."

Kahneman, D. (2011). *Thinking, Fast and Slow,* p 37. Farrar, Straus & Giroux, New York, NY.

Causes and Consequences of GPM Cognitive Ease * which are causes and which are consequences?

Time-scaled Logic Diagram

Clarity of Display

Gap/Drift/Float Math

Planning/Scheduling Fusion

Communal

COGNITIVE EASE

Anomalies stand out

Float pattern is preserved

Graph optimizes System 1 Thinking

Information rich suitable for System 2 thinking

Causes and Consequences of CPM Cognitive Strain

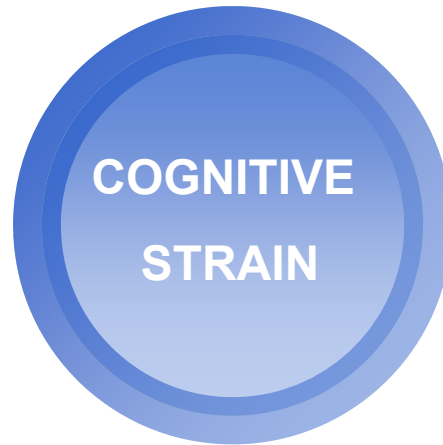Tabular printouts

Over-reliance on constraints

Total float seen as function of dates v logic

Complex software requires SMEs

Steep learning curve

COGNITIVE STRAIN

Anomalies can be hidden

Float pattern is easily corrupted

Display is anachronistic

Un-useful for both System 1 and system 2 thinking

A Machine For Jumping to Conclusions

- ## Conscious doubt is not in the repertoire of System 1

  - System 1 is gullible and biased to belief

  - The confirmatory bias of System 1 favors uncritical acceptance of suggestions and exaggeration of the likelihood of extreme and improbable events

- ## Uncertainty and doubt are the domain of System 2

  - System 2 is in charge of doubting and unbelieving, but System 2 is sometimes busy, and often lazy

  - The validity of System 2 choices and judgments

What You See Is All There Is (WYSIATI)*

- An essential design feature of System 1 is that it represents only activated ideas

    – Information that is not retrieved (even unconsciously) from memory might as well not exist

    – System 1 excels at constructing the best possible story that incorporates ideas currently activated, but it does not (cannot) allow for information it does not have

- GPM with its; time-scaled network, display of activity drift and float, and logic tie gaps, enhances System 1 thinking

What Happens When Information Is Scarce*

- When information is scarce, which is a common occurrence, System 1 operates as a machine for jumping to conclusions

- System 2 works hard, but without necessary information it may cop-out by answering a different question from that asked

My Intent has been to Use Kahneman's Work to Alert Analysts to the Following Potential Pitfalls

- There are distinctive patterns in the errors people make

- Systematic errors are known as biases, and they recur predictably in particular circumstances

- Much of the error in judgments and choices are biases of intuition

- As we analyze a schedule, our intuitive judgments are usually justified, but not always

- We are often confident even when we are wrong

- An objective observer is more likely to detect our errors than we are

The Possibility of Conflicts Between the Two Systems Suggests the Following

- Schedules are better if sufficiently simple to be read and understood by stakeholders

- A profession where schedulers on opposing sides favor quality schedules is preferable to one in which the better scheduler is best at obfuscation

- System 1 and System 2 harmonize better when a schedule is clear, simple and salient features are disclosed in the open for all to see

- Presentation greatly matters

The Possibility of Conflicts between the Two Systems Suggests the Following, cont'd

- System 1 registers the cognitive ease with which it processes information, but it does not generate a warning signal when it becomes unreliable

- System 1 is not readily educable

- The way to block errors that originate in System 1 is simple in principle

    – Recognize that you are in a cognitive minefield, slow down and ask for reinforcement from System 2

    – Imposing orderly procedures and following checklists will avoid errors

Know your Scheduling Algorithm *

- Develop a working knowledge of gap/drift/float math

- When sliding or stretching an activity, the fragnet that starts on the activity's successors slides based on existing zero-gap links

- When back-sliding or crashing an activity, the fragnet that starts on the activity's successors backslides where zero gaps exist to the extent permitted by connecting links not involved in the backslide

- To override the zero-gap rule, GPM algorithms must be turned off
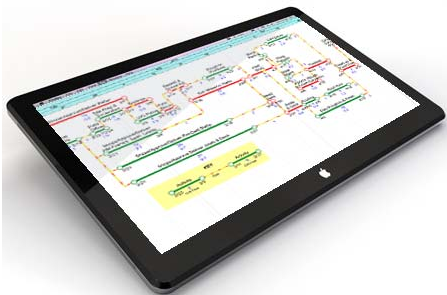
Even the Media is on to Kahneman's Ideas

BUSINESS TECHNOLOGY | JANUARY 4, 2012

So, What's Your Algorithm?

By DENNIS K. BERMAN

We are ruined by our own biases. When making decisions, we see what we want, ignore probabilities, and minimize risks that uproot our hopes.

What's worse, "we are often confident even when we are wrong," writes Daniel Kahneman, in his masterful new book on psychology and economics called "Thinking, Fast and Slow."

An objective observer, he writes, "is more likely to detect our errors than we are."

In a Clear and Simple schedule, Salient Features are readily apparent (obvious) to a trained eye, Decision-making and What-if Scenarios Can Better be Accomplished as the Intuitive and Deliberate Thinking Systems Synergyze
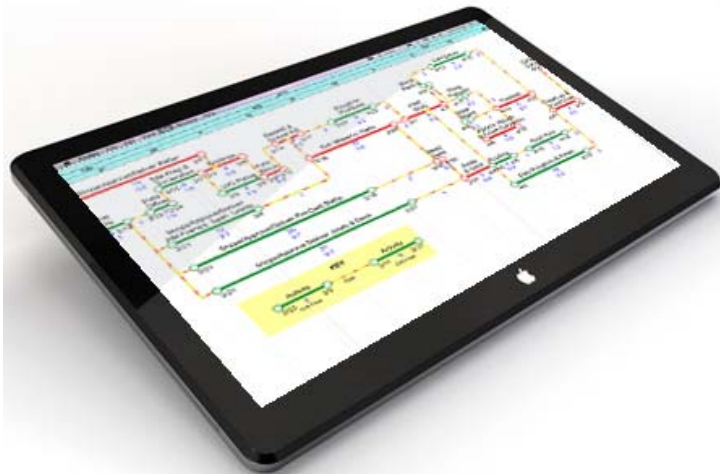
Q & A

Thank You

Gui Ponce de Leon PhD, PE, PMP, LEED AP
Inventor of GPM® and Developer of NetPoint®