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Defining Standards for Web Page Performance in Business Applications

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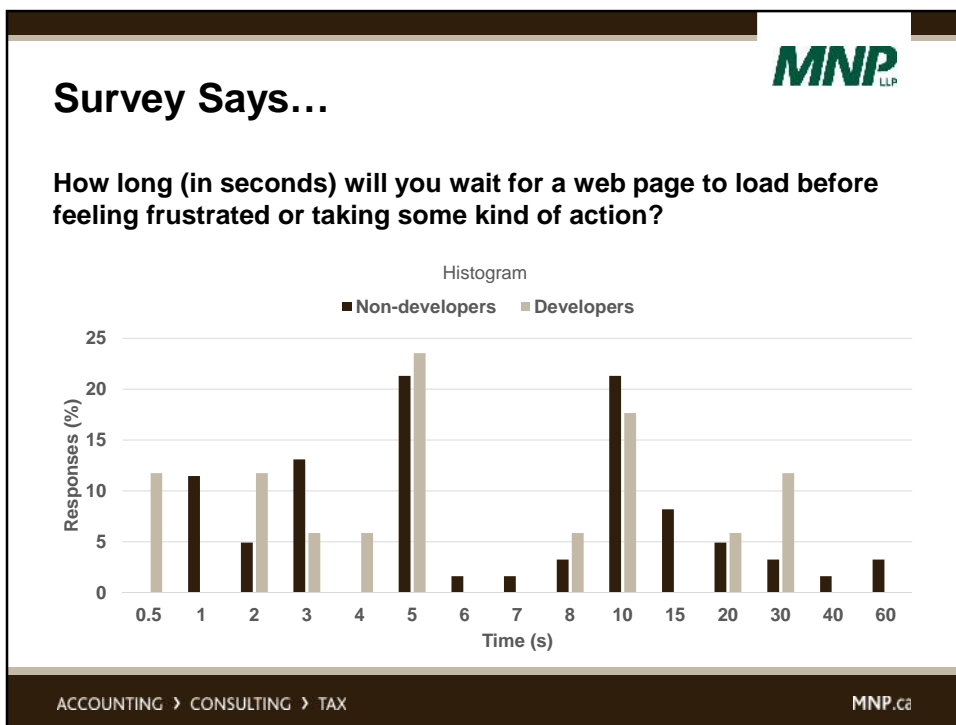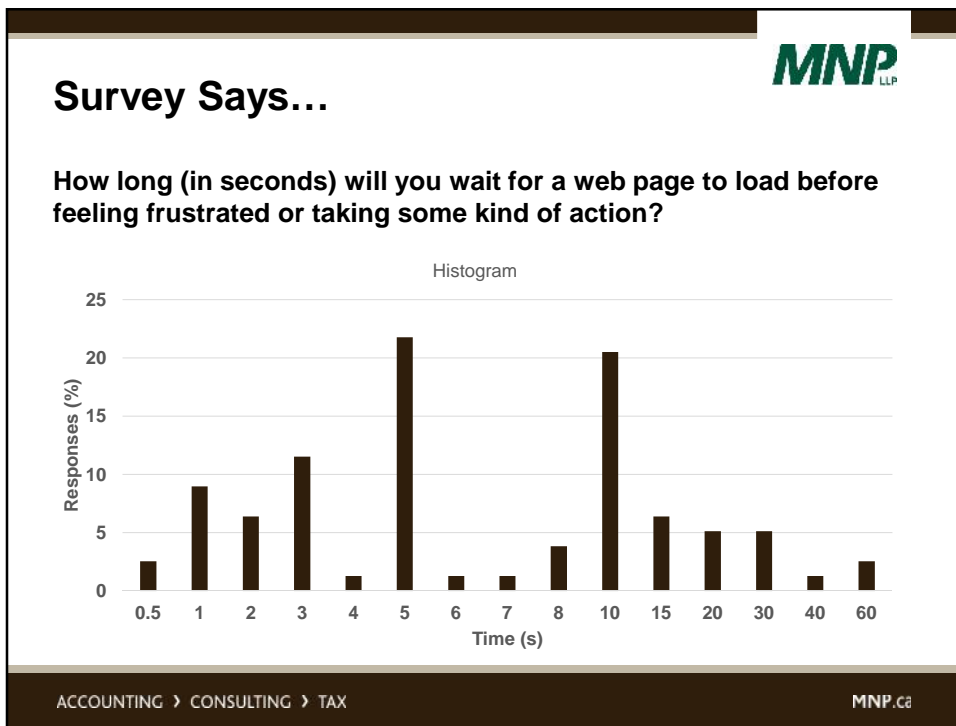

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My Job

- Educating Clients about Performance Engineering

- Building a Performance Strategy

- Testing Applications

- Measuring and Monitoring Performance

- Issue Resolution

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Survey Says…

How long (in seconds) will you wait for a web page to load before feeling frustrated or taking some kind of action?

Histogram

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Survey Says…

How long (in seconds) will you wait for a web page to load before feeling frustrated or taking some kind of action?

Histogram

■ Non-developers ■ Developers

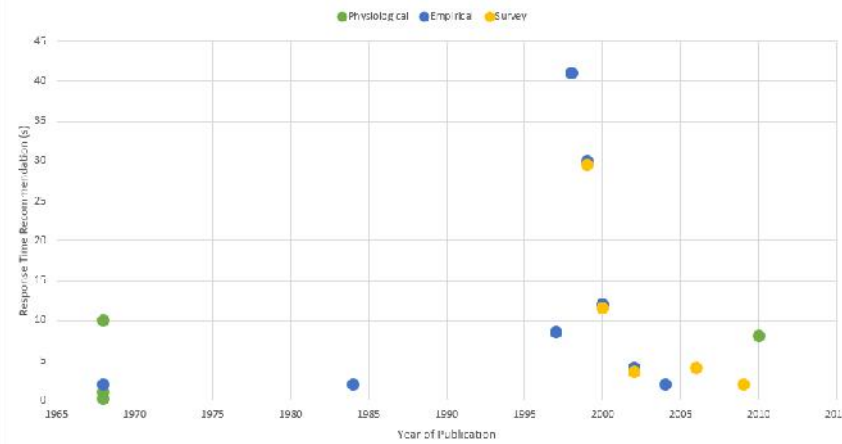ACCOUNTING › CONSULTING › TAX

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Challenge

- Set accurate and precise performance requirements

- Participation from business and developers

- Buy-in from all parties involved

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Industry Standards

Recommendations by Year and Study Format

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Physiological Measurements

Powers of 10 thresholds (Miller, 1968)
- Instantaneous reaction (0.1s)
- Continuity of thought (1.0s)
- Focus on dialogue of interaction (10s)

Awareness of waiting begins at 2s

Break in thread of communication at 4s

Attention atrophy (Nielsen, 2010)

Delay of 8s causes a 95% drop in user attention (Nielsen, 2010)

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Empirical Studies – Impact of Feedback

Nah, 2004
- Providing feedback doubles wait time tolerance
- Improves abandonment rates for slow responding pages
- Effective even after conditioning for instantaneous responses

Without Feedback	Mean	Median	Mode
First Response Failure	13s	9s	5-8s
Second Response Failure	4s	3.6s	2-4s
Third Response Failure	3.3s	2.5s	2-3s

With Feedback	Mean	Median	Mode
First Response Failure	37.6s	22.6s	15-16s, 20-22s, 45-46s
Second Response Failure	17s	8.4s	2-3s
Third Response Failure	6.7s	4.3s	2-3s

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Case Study – System Under Scrutiny

A passive, observational study of actual system performance and user behavior of a business application in production.

- Primary client information tracking and incident reporting system with an international company
- Industry-leading software platform supplied by a reputable international vendor
- 1200 users across 5 time zones in Canada and the United States by employees who are required to do so as part of their primary duties
- Peak usage is 800 simultaneous login, 50,000 page requests per hour over a 4 hour window.
- Average weekday receives 440,000 page requests with peak of 510,000 on the busiest day of the week, and 10,000,000 per month.

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Case Study – Results

System response times aggregated by month, presented as percentiles within 0.5s thresholds

	Percent of Requests Completed within Range					
	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Oct 2013
< 1.0 s	64.43	63.82	59.98	67.87	69.06	70.22
< 1.5 s	80.65	79.62	76.18	81.57	83.76	87.27
< 2.0 s	87.47	86.18	82.83	87.17	89.62	92.17
< 2.5 s	91.40	90.40	87.32	91.01	93.37	97.81
< 3.0 s	93.64	92.72	89.94	92.76	95.27	
< 3.5 s	94.94	94.12	91.65	93.82	96.29	
< 4.0 s	95.82	95.09	92.94	94.82	97.00	
< 4.5 s	96.51	95.88	94.05	96.01	97.66	
< 5.0 s	97.11	96.57	95.02	96.83	98.23	

	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Oct 2013
Complaints	17	20	22	21	13	0

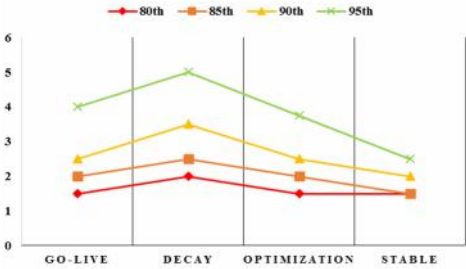ACCOUNTING › CONSULTING › TAX   MNP.ca

Case Study – Major Percentiles

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Based on this study we have sufficient information to set performance goals for future systems as follows:

• 95% of all page requests must be completed within 2.5s

Percentile	Go-live (Jan/Feb 2012)	Decay (Mar 2012)	Optimization (Apr/May 2012)	Stable (Oct 2013)
80th	<1.5s	<2.0s	<1.5s	<1.5s
85th	<2.0s	<2.5s	<2.0s	<1.5s
90th	<2.5s	<3.5s	<2.5s	<2.0s
95th	<4.0s	<5.0s	<3.0s/<4.5s	<2.5s
Complaints per Month	18.5	22	17	0

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Process – Gathering Requirements

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Goal: Establish a performance requirements definition process that takes advantage of business user's input and experience and produces a result that closely matches case study observations.

To match the case study, we require:
• 95% of all web page requests achieve end-to-end response time of 2.5s or less
• A majority of individual page performance targets achieve 2.0s or less
• A limited number of pages may have larger performance targets, these must be identified as candidates for additional response feedback.

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Process – Categorization

Define a set of page performance categories with examples and pre-set performance targets.

Individual pages are considered to have passed when:
- Under typical load – percentile response time measurement meets Target, overall maximum response time meets Maximum
- Under heavy (peak) load – percentile response time measurement meets Maximum

Category Name	Target Response Time	Maximum Response Time	Stability (Percentile)
Basic Operations	<2 s	<2 s	95th
Complex or Ambiguous Search or Save Operations	<5 s	<5 s	90th
Integration or Major Calculation Operations	<5 s	<15 s	85th
Heavyweight Operations	<10 s	<30 s	85th

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Process – Page Aggregates

Result:

Category Name	# of Pages	% of Total Pages
Basic Operations	222	85.71
Complex or Ambiguous Search or Save Operations	29	11.20
Integration or Major Calculation Operations	1	0.39
Heavyweight Operations	7	2.70

Weighted averages for all pages:
- Target Response Time: 2.56s
- Maximum Response Time: 3.14s

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Process – Request Aggregates

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Performance requirement categorizations were then adjusted for the frequency of usage

Result:

Category Name	# of Page Requests During Test Cycle	% of Total Page Requests
Basic Operations	353,737	89.54
Complex or Ambiguous Search or Save Operations	33,550	8.49
Integration or Major Calculation Operations	2,942	0.74
Heavyweight Operations	4,819	1.21

Weighted averages for all page requests based on frequency:

- Target Response Time: 2.37s
- Maximum Response Time: 2.69s

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Conclusions

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Industry performance standards are widely variable and inconsistently structured and researched. However, a careful study of a web application that exists in a controlled environment shows that the actual wait time tolerance of the users in the study closely aligns with the most popular performance recommendations of <2s.

By using this case study to pre-define performance target categories with assistance from business analysts and system developers, business users with no particular training or experience with performance requirements were able to independently define performance requirements that closely aligned with the observed optimal performance state of an existing production application.

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