1HZ <RUN 6WDWH([HFXWLRQ LQ /LYLQJ (QYLURQPHQW

7HFKQLFDO 5HSRUW

3UHSDUHG IRU WKH 1HZ <RUN 6WDWH (GXFDWLRQ
E\ 3HDUVRQ

-XQH

&RS\ULJKW

'HYHORSHG DQG SXEOLVKHG XQGHU FRQWUDFW ZLWK WKH 1HZ 3HDUVRQ

&RS\ULJKW ‹

&KDSWHU ,QWURGXFWLRQ

,1752'8&7,21

7KLV FKDSWHU SURYLGHV DQ RYHUYLHZ RI WKH WZR PRVW IDP
FODVVLFDO LWHP DQDO\VLV LWHP GLIILFXOW\ DQG LWHP GLVFU
RSHUDWLRQDO 5HJHQWV ([DPLQDWLRQ LQ /LYLQJ (QYLURQPHQW

,7(0 ',))&8/7<

$W WKH PRVW JHQHUDO OHYHO DQ LWHP¶V GLIILFXOW\ LV LQG
JURXS H J JUDGH OHYHO FDOFXODWHG DV IROORZV

$$\bar{x}_{[} = \frac{\sum_{L}^{Q} x_{[}}{Q}$$

7KH LQGLYLGXDO LWHP VFRUHV DQG WKHQ GLYLGHG E\ WKH WRW

,7(0 ',6&5,0,1$7,21

$W WKH PRVW JHQHUDO OHYHO HVWLPDWHV RI LWHP GLVFULPLQ
EHWZHHQ KLJK DQG ORZ SHUIRUPDQFH RQ DQ H[DP ,W LV H[SHF
WKH H[DP ZRXOG EH PRUH OLNHO\ WR DQVZHU DQ\ JLYHQ LWHP FRU
L H WKRVH ZKR SHUIRUP SRRUO\ RQ WKH H[DP RYHUDOO ZRX
LWHP LQFRUUHFWO\ 3HDUVRQ¶V SURGXFW PRPHQW FRUUHODWL
DSRLQW ELVHULDO EHWZHHQ LWHP DQG WRWDO VFRUHV DQG WHVW VFRUHV LV XV
3HDUVRQ 7KH FRUUHODWLRQ FRHIILFLHQW FDQ UDQJH IUR
WHQG WR JHW WKH LWHP FRUUHFW ZKLOH ORZ VFRULQJ VWXGHQ
VFRUH DQG WKH WRWDO WHVW VFRUH ZLOO EH ERWK SRVLWLYH D
LQGLFDWLQJ WKDW WKH LWHP LV OLNHO\ GLVFULPLQDWLQJ ZH

,WH	6WXGH S 9DO	6'	3RLQ %LVHL	3RLQW %LVHUI 'LVWUDF	3RLQW %LVHUI 'LVWUDF	3RLQW %LVHUI 'LVWUDF

	,WH	6WXGH	0LQ 6FRU	0D[6FRUI	0HDQ	6'	S 9DO

° W D W D PEp ` U

,WHP)LW

$Q LPSRUWDQW DVVXPSWLRQ RI WKH 5DVFK PRGHO LV WKDW
:,167(36 SURYLGHV WZR LWHP ILW VWDWLVWLFV ,1),7 DQG 287),7
WKH 5DVFK PRGHO SUHGLFWV WKH REVHUYHG LWHP UHVSRQVHV
VWDWLVWLF FDQ EH H[SUHVVHG DV D PHDQ VTXDUH 0Q6T VWDV
ZLWKPHDQ DQG YDULDQFH 0Q6T YDOXHV DUH PRUH RULHQ
ZKLOH =VWG YDOXHV DUH PRUH RULHQWHG WRZDUG VWDWLVWL
DYHUDJH RI VWDQGDUGL]HG UHVLGXDO YDULDQFH WKH GLIIHUH
5DVFK HVWLPDWHG VFRUH GLYLGHG E\ WKH VTXDUH URRW RI W
VWDWLVWLF LV ZHOO DSSUR[LPDWHG E\ D VWDQGDUGL]HG QRUPDO GLIILFXOW\ DQG WHQGV WR
UHVSRQVHV

VFDOH VFRUH HTXLYDOHQW IRU WKH 5DVFK WKHWD VFRUH FRUU
QHZ IRUP XVLQJ WKH VFDOH UHODWLRQVKLS HVWDEOLVKHG LQ
YLD OLQHDU LQWHUSRODWLRQ

7KLV SURFHVV UHVXOWV LQ D UHODWLRQVKLS EHWZHHQ WKH UD
VFRUHV 7KH VFDOH VFRUHV FRUUHVSRQGLQJ WR HDFK UDZ VFRU
IRU UHSRUWLQJ RQ WKH FRQYHUVLRQ FKDUW SRVWHG DW WKH
H[FHSWLRQV DUH IRU WKH PLQLPXP DQG PD[LPXP UDZ VFRUHV D
WKH VFDOHG FXW VFRUHV RI DQG 7KH PLQLPXP DQG
DVVLJQHG VFDOH VFRUHV RI ,I DQ H[DPLQHH DWWHPSWHG OHVV WK
Z˜H 0 –PXP XP

5HOLDELOLW\ LV PRVW RIWHQ HVWLPDWHG XVLQJ WKH IRUPXO
SUDFWLFDO LQWHUQDO FRQVLVWHQF\ LQGH[&RHIILFLHQW DOS
ZKLFK DQ H[FKDQJHDEOH VHW RI LWHPV IURP WKH VDPH GRPDLQ
RI VWXGHQWV 5HODWLYH HUURU LV UHIOHFWHG LQ WKLV LQGH
IURP RQH VDPSOH RI LWHPV WR WKH QH[W VKRXOG EH RI SDUW
XVHU $ JHQHUDO FRPSXWDWLRQDO IRUPXOD IRU FRHIILFLHQW D

[redacted]

ZKHUH LV WKH QXPEHU RI SDUWLFLSDQWV LV WKH YDULDQFH RI WKH REVHUYHG V
LV WKH YDULDQFH RI SDUW

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5HOLDELOLW\ FRHIILFLHQWV EHVW UHIOHFW WKH H[WHQW WR Z
SUHVHQW RU DEVHQW 7KH VWDQGDUG HUURU RI PHDVXUHPHQW
SUHFLVLRQ WKDW LV EHWWHU VXLWHG IRU GHWHUPLQLQJ WKH I
VFRUHV REWDLQHG E\ LQGLYLGXDO H[DPLQHHV 7KLV LV SDUWLF

7UDGLWLRQDO 6WDQGDUG (UURU RI 0HDVXUHPHQW

7KH 6(0 LV GHILQHG DV WKH VWDQGDUG GHYLDWLRQ RI WKH GLVW
ZLWK LGHQWLFDO WUXH VFRUHV 7KHRUHWLFDO DVVXPSWLRQV DERXW WKH UDQGRP Y
VFRUHV LQ WHVW VFRUH XQLWV DQG WKHUHIRUH UHSUHVHQWV L

$$SEM = SD\sqrt{1 - \alpha}$$

7KLV IRUPXOD LQGLFDWHV WKDW WKH YDOXH RI WKH 6(0 GHSHQ
FRHIILFLHQW DQG WKH VWDQGDUG GHYLDWLRQ RI WHVW VFRUHV ,
WKH ORZHVW SRVVLEOH YDOXH WKH 6(0 ZRXOG EH HTXDO WR
,I WHVW UHOLDELOLW\ ZHUH HTXDO WR WKH KLJKHVW SRVVL
D SHUIHFWO\ UHOLDEOH WHVW KDV QR PHDVXUHPHQW HUURU
WDNHV WKH JURXS YDULDWLRQ L H VFRUH VWDQGDUG GHYLDW
RQ D SRLQW WHVW ZRXOG EH YHU\ GLIIHUHQW IURP DQ 6(0 RI

7UDGLWLRQDO 6WDQGDUG (UURU RI 0HDVXUHPHQW &RQILGH

7KH 6(0 LV DQ LQGH[RI WKH UDQGRP YDULDELOLW\ LQ WHVW VF
LV ZK\ LW KDV VXFK JUHDW XWLOLW\ IRU WHVW VFRUH XVHUV 6(

7DEOH SUHVHQWV WKH FRHIILFLHQW DOSKD DQG DVVRFLDWHG 6
/LYLQJ (QYLURQPHQW

7DEOH &RHIILFLHQW $OSKD DQG 6WDQGDUG (UURU RI DPLQDWLRQ LQ /LYLQJ (QYLURQPHQ

&RHIILFLHQW	6(0

$VVXPLQJ QRUPDOO\ GLVWULEXWHG VFRUHV RQH ZRX5Y„€ G)˜H

M M M

M M M M M

7KH VXP RI WKH GLDJRQDO HQWULHV L H WKH SURSRUWLRQ R
WKH VDPH SHUIRUPDQFH RYHUDOO FRQVLVWHQF\

7DEOH 3VHXGR 'HFLVLRQ 7DEOH IRU 7ZR +\SRWKHWLFDO &DWHJRULHV

7DEOH SUHVHQWV WKH UHVXOWV IRU WKH GLFKRWRPLHV FUHDWH
)RU H[DPSOH WKH VWDWLVWLFV XQGHU ³ ´ LQGLFDWH WKH GH
SHUIRUPDQFH OHYHOV DUH GLYLGHG LQWR WZR FDWHJRULHV R
OHYHO DQG WKH RWKHU IRU WKH WKLUG DQG KLJKHU SHUIRUP
ZLWK WKH %%&RODVVHV DQG XVLQJ WKH /LYLQJVWRQH DQG /HZ
GHFLVLRQ FRQVLVWHQF\ DQG DFFXUDF\ YDOXHV DUH K
DQG DFFXUDF\ RI VWXGHQW FODVVLILFDWLRQV

7DEOH Y RW ™–^Q'%•0

7DEOHSUHVHQWV WKH VWDWH SHUFHQWLOH UDQNLQJV EDVHG RQ WDNLQJ WKH 5HJHQWV ([DPLQDWLRQ LQ /LYLQJ (QYLURQPHQW IRU VFRUHV IRU UDQJH IURP WR DQG VRPH VFDOH VFRUHV PD\ UDZ VFRUH VFDOH VFRUH UHODWLRQVKLS IRU D VSHFLILF DGPLQL FRPSXWHG LQ WKH IROORZLQJ PDQQHU

- $ VWXGHQW¶V DVVLJQHG ³VWDWH SHUFHQWLOH UDQN´ ZLOO VFRULQJ DW WKH LPPHGLDWH ORZHU VFRUH SOXV KDOI RI W JLYHQ VFRUH
- 6WXGHQWV ZKR REWDLQ WKH KLJKHVW SRVVLEOH VFRUH ZLO

7DEOH6WDWH 3HUFHQWLOH 5DQNLQJ IRU 6FDOH 6FRUH 5HJHQWV ([DPL

6FDO 6FRU	3HUFHQ 5DQN	6FDO 6FRU	3HUFHQ 5DQN	6FDO 6FRU	3HUFHQ 5DQN	6FD 6FR	3HUFHQ 5DQN

&KDSWHU 9DOLGLW\ 6WDQGDUG

7R UHVWDWH WKH SXUSRVHV DQG XVHV RI WKH 5HJHQWV ([DPLQ
PHDVXUHV VWXGHQW DFKLHYHPHQW DJDLQVW WKH 1<6 /HDUQL
WHDFKHU H[DPLQDWLRQ 1<6 (QYLURQPHQWDO 6FDQ DQG WHVWLQJ VS
SURYLGHV WHDFKHUV DQG VWXGHQWV ZLWK LPSRUWDQW LQI
SHUIRUPDQFH DJDLQVW WKH HVWDEOLVKHG FXUULFXOXP VWDQG
LGHQWLI\ VWXGHQW VWUHQJWKV DQG QHHGV ZKLFK PD\ WKHQ E
OHDUQLQJ 7KH H[DP DOVR SURYLGHV VWXGHQWV SDUHQWV F
DGPLVVLRQV RIILFHUV ZLWK REMHFWLYH DQG HDVLO\ XQGHUVW
XVHG WR LQIRUP HPSLULFDOO\ EDVHG HGXFDWLRQDO DQG YRFDV

&+(&./,67 2) 7(67 &216758&7,21 35,1&,3/(6
0XOWLSOH &KRLFH ,WHPV

	<(6	12
,V WKH LWHP VLJQLILFDQW"		
'RHV WKH LWHP KDYH FXUULFXODU YDOLGLW\"		
,V WKH LWHP SUHVHQWHG LQ FOHDU DQG VLPSOH ODQJXDJH NHSW DV VLPSOH DV SRVVLEOH"		
'RHV WKH LWHP KDYH RQH DQG RQO\ RQH FRUUHFW DQVZHU"		
'RHV WKH LWHP VWDWH RQH VLQJOH FHQWUDO SUREOHP FR VWHP" 6HH +HOSIXO +LQW EHORZ		
'RHV WKH VWHP LQFOXGH DQ\ H[WUDQHRXV PDWHULDO ³ZLQG		
$UH DOO UHVSRQVHV JUDPPDWLFDOO\ FRQVLVWHQW ZLWK WK ZLWK RQH DQRWKHU LQ IRUP"		
$UH DOO UHVSRQVHV SODXVLEOH DWWUDFWLYH WR VWXGH LQIRUPDWLRQ WHVWHG E\ WKH LWHP "		
$UH DOO UHVSRQVHV LQGHSHQGHQW DQG PXWXDOO\ H[FOXVL		
$UH WKHUH DQ\ H[WUDQHRXV FOXHV GXH WR JUDPPDWLFDO I YHUEDO DVVRFLDWLRQV OHQJWK RI UHVSRQVH HWF "		
:HUH WKH SULQFLSOHV RI 8QLYHUVDO 'HVLJQ XVHG LQ FRQ LWHP"		

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7R GHWHUPLQH LI WKH VWHP LV FRPSOHWH PHDQLQJIXO DOO E\

- &RYHU XS WKH UHVSRQVHV DQG UHDG MXVW WKH VWHP
- 7U\ WR WXUQ WKH VWHP LQWR D VKRUW DQVZHU TXHVWLRQ LV QRW DVVRFLDWHG WKH VWHP LWHP WKDW VKRXOG EH WHVWHG LWHP WKH VWHP
- 7KH VWHP PXVW FRQVLVW RI D VWDWHPHQW WKDW FRQWDLQ