Localisation Issues of Software Shortcut Keys

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Abstract

No common agreement exists on whether all shortcut keys should be localised during software localisation or not. The main argument in favour of the localisation of shortcut keys is a possibility to preserve mnemonics in the target language, whereas the main argument against their localisation is a possibility to maintain uniform command letters in the source and target languages. The aim of this paper is to investigate the localisation of shortcut keys and find a compromise between the contradictions mentioned above. The statistics of letters used in the command keys (i.e., Ctrl+letter) of 50 popular computer programs have been collected and analysed. The stability of command-letter pairing among different programs is evaluated and the recommendations for localisers are presented. The recommendations are based on the existing traditions of software design, existing practices of the major software producers, and the stability of command-letter pairing. The letters of command keys are divided into three main categories according to the strength of the relationship between the command and the letter. The categories are as follows: international (not to be localised), those that may be localised, and those that should be localised. Features of the combinations of the command keys with numbers and special characters are discussed as well. One more finding is that the Ctrl+Alt combination in the source program must be considered as an internationalisation error, since almost all languages that use the Latin script have letter keys with some characters on the third keyboard level, and the aforementioned key combination is equivalent to Alt Gr which is the recognised key to access third level characters.

Keywords: *shortcut key localisation, access key localisation, command key localisation, software localisation, software internationalisation.*

1. Introduction

Shortcut keys are used to provide an alternate and, usually, quicker way of navigating and invoking the operations of software programs. Different manufacturers name shortcut keys differently, e.g. shortcuts or hotkeys. The two main types of shortcut keys, in most software applications, are command keys and access keys.

A command key is a keyboard key (e.g. *F1*, *Home*) or a finite combination of keyboard keys (e.g. *Ctrl+C*) that is used to invoke a command associated with the key. The activity scope of command keys is a part of a program, an entire program, or a whole platform, e.g. an operating system.

Access keys are usually made up by combining the *Alt* key with a single letter, e.g., *Alt+F*, *Alt+Ž*. They are used to provide an alternate method to access drop-down menu functions of the software. They either open a lower level menu or execute a command, if there is no lower level menu. Access keys are only valid in a limited context, i.e., usually in a certain level of a drop-down menu or in a dialog box view where the appropriate command name is used.

The letter, used in an access key combination, is called a mnemonic letter. It usually reflects the name of a command. The mnemonic letters usually appear as underlined letters in the associated command names, for instance, *File*, *Edit*, and *Help* on a menu bar. These letters are always localised. The question of whether one of these letters should be localised or not does not arise since the letter to be underlined must be included in the localised (translated) command name. Otherwise they are referred to separately, e.g. *Datei F* for *File* command in German localisation. It is natural that the word, which is translated to the target language, may not have the same letter to underline as the original word. However, command keys are not localised in many cases. Thus, this article focuses on the problems of

localising command keys only.

Command key combinations are usually obtained by pressing a modifier key, marked with *Ctrl* (*Strg* in the German keyboard, *Vald* in the Lithuanian keyboard, etc.), or with the ⌘ sign on Apple computer keyboards. This paper will use the English abbreviation *Ctrl* to refer to this kind of a modifier key.

The validity scope of command keys is broader than that of access keys. Command keys present more universal functions compared to access keys. Therefore, the appropriate letters in command key combinations during localisation have to be selected with great care. Naturally, the letter should resemble the command in some way, e.g. be the same as the first letter of the command name, or have another relationship with the command operation, e.g. the letter *X* in the key of *Cut* command *Ctrl+X* resembles scissors, meanwhile the plus sign is suitable for the *Zoom in* command key (*Ctrl++*), and minus is suitable for the command key *Zoom out* (*Ctrl+–*).

English version		Localised version (Lithuanian example)	
Replace	Ctrl+R	Pakeisti	Vald+R
Edit	Ctrl+E	Taisyti	Vald+E
Select All	Ctrl+A	Žymėti viską	Vald+A

Table 1: The discrepancies between localised access keys and command keys letters

The shortcut keys use the keyboard level principle to add extra functionality to existing keys. As not all of these levels are used throughout different locales, we will explain the concept of the keyboard levels in more detail. A keyboard key, located in the alphanumeric part of the keyboard, may have one, two or more characters associated with it. The more characters a locale uses, the more characters are associated with the key.

Keyboard level 1 is a keyboard state that is accessed when the first character, associated with the key is entered by pressing that key (usually, a lower case letter of the alphabet). No modifier key is used to access level 1 of the keyboard. Level 2 is a keyboard state that is accessed when the second character, associated with the key is entered (usually, a capital (uppercase) letter or a number in some locales). Level 2 is activated when *Shift* key is pressed.

Finally, level 3 is a keyboard state that allows the third character, associated with the key to be entered. Level 3 is activated by holding the *Alt Gr* key and is used in many locales (German, French, Polish, Lithuanian, etc.) to enter special characters as quotation marks, the euro sign, mathematical symbols, etc. More details on the level 3 characters in different locales will be given in Table 6.

There is no consensus on the localisation of command keys. Hall and Hudson (1997) state that command keys should be localised because the letters should be meaningful, i.e. reflect the name of a command the key invokes. For example, in the English user interface, the key of the command *Print* should use the first letter of the command name (*Ctrl+P*). Whereas in other languages the letter *P* carries no meaningful information about the printing command since the name of the localised command starts with a different letter, e.g. *Drucken* in German, *Tulosta* in Finnish, and *Stampa* in Italian. A similar situation arises with many other commands. In Lithuanian, out of 26 English letters, only one command key *Vald+N* (*Ctrl+N*) has meaningful information: *N* – *Naujas* (*New*) (Grigas and Strelkauskytė 2011).

The discrepancies between localised and non-localised command key letters are clearly visible when command names, access keys and command keys are displayed side by side on the menu bar (Table 1).

Müler (2009) considers shortcuts and hotkeys as important elements of the user interface, to be internationalised and localised, that have to be included in test tasks of the user interface. The scholar does not observe any exceptional rules for the localisation of command keys: “Typically test tasks ensure that each UI element is internationalized and localizable, including menus, field labels, buttons, tooltips, hotkeys, shortcuts, messages, combo boxes and icons” (Müler 2009, p. 14). There are recommendations to distinguish mnemonics from keyboard shortcuts and not to localise keyboard

shortcuts. "Mnemonics are distinguishable from keyboard shortcuts. One difference between them is that the keyboard shortcuts are not localized on multi-language software but the mnemonics are generally localized to reflect the symbols and letters used in the specific locale" (Keyboard Shortcut 2012). Safar and Machala emphasise the importance of conformity of localisation in different software: "Ideally, existing shortcuts should not change between releases and should have a high degree of conformity with the operating system or similar and related applications" (Safar and Machala 2010, p. 3). Esselink (2000, p. 72) states that command keys may be localised, but special attention needs to be paid to special characters (@ $ { } [ ] \ ~ | ^ ‘ <>), which can cause problems when a non-English keyboard layout is used (the author was referring to the U.S. keyboard here and it should be noted that these characters can cause problems in the keyboard layout of the United Kingdom as well). During the development of international software Esselink (p. 34) also recommends using function keys instead of letters in shortcut key combinations (e.g. *Ctrl + F3*).

One of the *Microsoft Office Word Help* documents states: "The shortcut keys described in this Help topic refer to the U.S. keyboard layout. Keys on other layouts may not correspond exactly to the keys on a U.S. keyboard" (Microsoft Corporation 2007).

As there is no consensus on the question of whether command keys should be localised or not, the command keys are not usually localised. The main reason for this is a statement that letters, corresponding to the commands, are well established, well-known, and, therefore, should not be localised. Not all software developers provide the option of changing letters during localisation. If such an option exists, it is usually recommended not to change the letters.

Letters that are often used for command keys in the original (English) software versions are easily memorised. Usually this is the first letter of the name of the command. This principle is not retained in the localised software and the statement that "the localised software should look and feel as if it has been developed in the target culture" (Schäler 2003) is ignored. Therefore, the question of how to reconcile such contradictions appears.

The versatile way is to perform a deeper examination of the situation and find a compromise. The letters that have been strongly "tied" to the commands may be left as non-localised, whereas other letters should be localised, i.e. changed to preserve the relationship with the localised command name in the target language. This paper aims to analyse a permanence of pairs of commands and single letters that are frequently used in software applications, and provide recommendations for international software developers and localisers on the basis of these findings. Original (non-localised) applications have been selected for the analysis for two reasons. Firstly, the process of localisation starts with the original software. Secondly, the data used from the localised software may not objectively reflect the situation due to the aforementioned arguments towards the non-localisation of shortcut keys. The purpose and mnemonics of numbers and special characters do not significantly differ in various languages. Thus, they are not analysed in this paper. However the layout of these characters differs in various languages and raises some localisation issues. Numbers on the U.S. English keyboard and many other keyboards are located on the first level (case). However in French, Belgian, and Lithuanian keyboards numbers are located on the second level. So the command key *Ctrl+3* on US English keyboard becomes *Ctrl+Shift+3* on the French keyboard.

Another problem relates to the special characters located on the third level. A US English keyboard has two levels. Other locales usually have three levels. On the U.S. keyboard layout all special characters are available on the first and second levels of the keyboard, while many of them are located on the third level on the keyboards used in other countries. Third level characters are obtained by pressing the *Alt Gr* key together with the corresponding character key, e.g. *Alt Gr + @*. Conflict arises when shortcut key *Alt Gr + @* is used in English software. A similar conflicting situation arises when *Ctrl + Alt* (left) + *special character* is used as shortcut key because the key combination *Ctrl + Alt* (left) is used to model *Alt Gr* key for older keyboards without this key.

Inconsistency may also arise due to differences in grouping special characters on different keyboard layouts (e.g. a dot and a colon are located on the same key on the German keyboard but not on the English keyboard).

2. The Analysis of Shortcut *Ctrl+letter* Usage

The analysis of the letters on the command keys has been based on 50 frequently used software programs. Programs for various purposes and from various distribution methods (open source, proprietary, and

Modifier key Ctrl+	Command 1		Command 2		Command 3		Command 4		Command 5	
	Command	Number	Command	Number	Command	Number	Command	Number	Command	Number
A	Select All	39								
B	Bold	9	Bookmarks	5						
C	Copy	40								
D	Deselect	5	Add bookmark	4	Duplicate	4	Font	3	Add a favorite	2
E	Center	8	Search	5	Edit	3	Export	3	E-Mail	2
F	Find	30	Search	4	Filter	3	Repeat	2		
G	Go To	9	Find Again	6	Find	4	Group	3		
H	History	7	Replace	5	Hide	3	Size	3		
I	Italic	9	Invert	5	Import	4	Information	4	Search	2
J	Justify	8	Downloads	3	Jump to	2				
K	Hyperlink	4	Check	2	Preferences	2				
L	Left	8	Open	3	Address field	2	Full screen	2	Levels	2
M	Message	2	Merge	2	Formatting	2				
N	New	35	Create	3						
O	Open	38								
P	Print	34	Copy	2	Preferences	2				
Q	Quit	11	Exit	9	Quick view	4				
R	Right	8	Refresh	6	Replace	6	Reload	4	Resize	2
S	Save	37								
T	New Tab	8	Text	2						
U	Underline	8	Source	7						
V	Paste	40								
W	Close	31								
X	Cut	39								
Y	Redo	18	Repeat	3	Crop	2				
Z	Undo	33	Comment	2						

Table 2: Information on command keys, presented according to the letters

commercial) have been selected. Most of the selected programs run on the MS Windows operating system while a number of them operate on Linux and MacOS. The majority of the programs have been localised into other languages (the number of existing localisations is one of the most important indicators of the popularity of the software).

The selected programs differ in size. To reduce the difference large software packages such as Microsoft Office and OpenOffice.org have been split into separate components (e.g. text processor, spreadsheets, and presentation editor). The data for the analysis has been taken from existing surveys (*Table of keyboard shortcuts 2012*), as well as studying the programs' documentation. Other data has been collected by carrying out experiments with running programs. The results of the analysis are presented in two ways: according to the letters, and according to the commands.

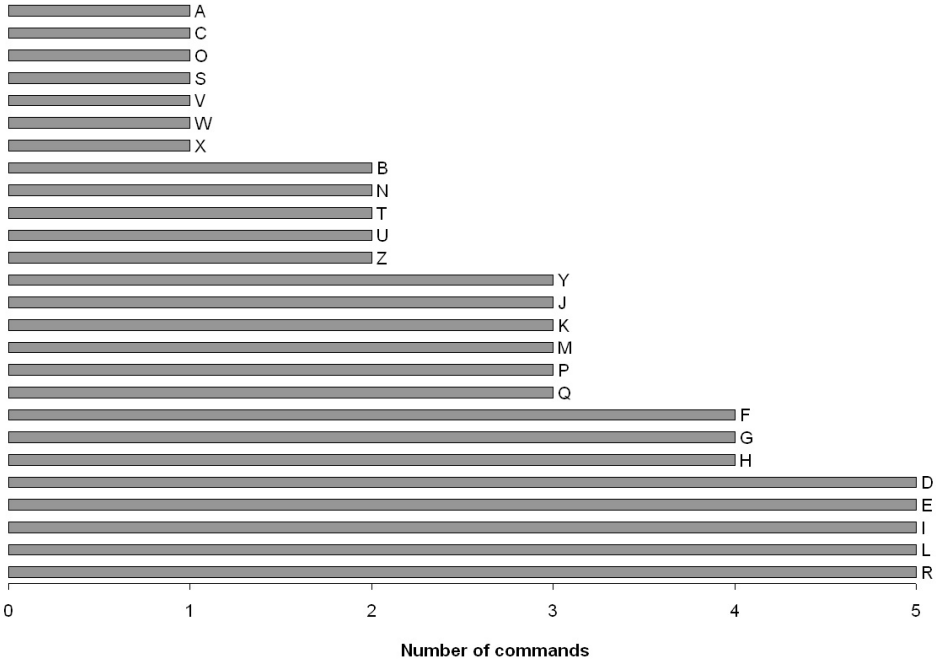

Figure 1: The number of programs, where the letter is associated with "the most popular" command

2.1 Results, presented according to the letters

Table 2 reveals information about the types of commands and in how many programs they correspond to each letter of the English alphabet. Five is the maximum number of commands that corresponds to the same letter, which has been observed in all the set of programs.

Each letter is presented by a row with five double columns for the commands using that letter. Each double column consists of two sub columns with the name of the command and the number of programs where the command is used. The first column depicts the largest number, which means that the command is more tightly associated with the corresponding letter.

Figure 1 presents the number of commands each letter is related to. This corresponds to the number of non-empty double columns in Table 2.

Letters associated with only one command may be considered as the ones that maintain a unique relationship with a single command. There are 7 such letters: *A, C, O, S, V, W*, and *X*.

Another important property is the number of programs where the letter is used (this feature is related to the column "Command 1" in Table 2, i.e. "the most popular") (Fig. 2). In fact the numbers come from Table 2, column "Command 1" and are presented graphically.

2.2 Results, presented according to the commands

Table 3 presents information about letters and

programs that are related to each command.

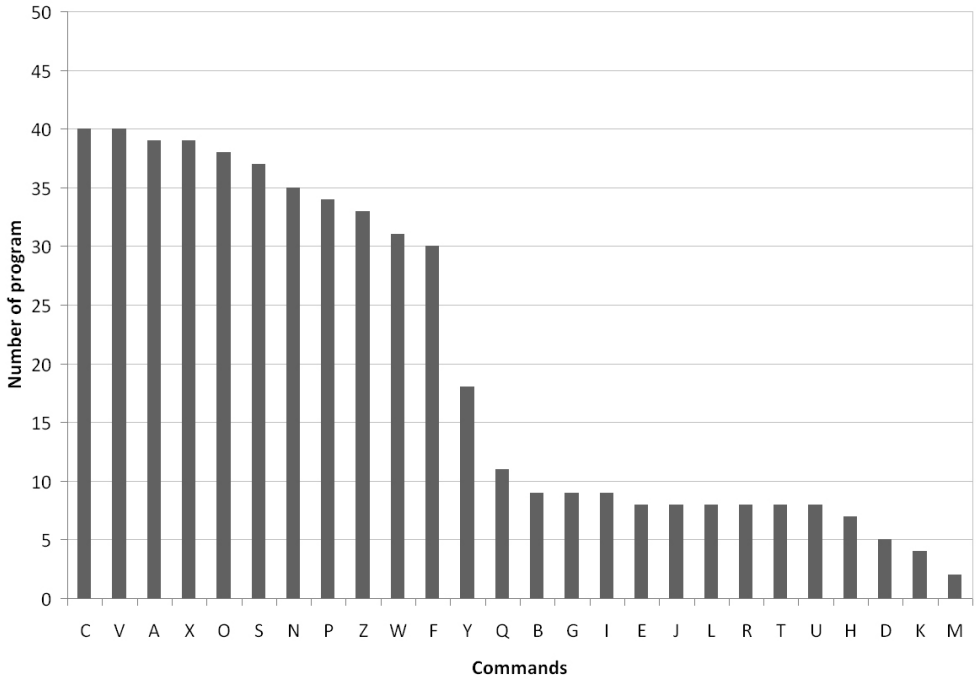

Figure 2: The number of programs, where the letter is associated with "the most popular" command

145 different commands were found in the 50 programs that were chosen for the analysis. It would be difficult to present all the data in a single table since such a table would consist of 50×145 cells. However, only the total numbers of commands are important for the analysis and not their distribution among the programs. Therefore, 14 frequently used programs, serving as an example set, have been included. The last column of the table provides information about the number of appropriate command keys in all other programs that have been examined and are not indicated in Table 3 (MS Office Power Point, Mozilla Thunderbird, Adobe Reader, etc.).

The commands, presented in Table 3 are sorted in descending order according to the number of programs that apply them. The larger the number, the stronger the relationship between the command and the letter is. The relationship is weaker if the same command is related to more than one letter. Four such commands are highlighted in Table 3: *Replace*, *Find*, *Search,* and *Open*.

One more factor that weakens the relationship between the letter and the command is the usage of the same letter for several different commands. In this case the priority is given to the command that is related to a larger number of letters. Such a relationship can be considered as the strongest one, while the relationship between all other commands with that letter can be considered as weak. The latter are highlighted after the commands with strong relationships in the grey shaded cells. The last command presented in the table, is *Message*. It is related to the final, and still unoccupied, letter M. After the letter M there are no commands marked by strong relationship.

2.3 Mnemonics of the letters

Data, presented in Table 3, can be analysed in terms of mnemonics of letters. Three commands, related to letters *X, V*, and *Z* do not bear direct relation to any of the letters contained in the English words such as *Cut*, *Paste*, and *Undo*. However, the visual representation of these letters reflects graphical icons of the commands, i.e., the letter *X* resembles scissors (the text or another object is cut); the letter *V* resembles an arrow pointing downward "into" the document to paste an object; whereas the letter *Z* signifies a zigzag, striking out a mistake. Therefore, the relationship between these three letters and their appropriate commands can be treated as an international (language independent) decision, and these command keys should not be localised. The

Command			Program														
Number of programs	Command name	Letter	Microsoft Word	Microsoft Excel	OpenOffice.org Write	OpenOffice.org Calc	AbiWord	Mozilla Firefox	Internet Explorer	SeaMonkey	Opera	Free Pascal	Gimp	Picasa	Skype	Total Commander	No of other programs
40	**C**opy	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	26
40	**Paste**	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	26
39	Select **A**ll	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	25
39	**Cut**	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	25
38	**O**pen	O	O	O	O	O	O	O	O	O	O	O	O	O			26
37	**S**ave	S	S	S	S	S	S	S	S	S	S	S	S	S			25
35	**N**ew	N	N	N	N	N	N	N	N	N	N	N	N	N		N	22
34	**P**rint	P	P	P	P	P	P	P	P	P	P		P	P			23
33	**Undo**	Z	Z	Z	Z	Z	Z	Z		Z	Z	Z	Z		Z		22
31	Close (**W**indow)	W	W	W	W	W	W	W	W	W	W		W			W	20
30	**F**ind	F	F	F	F	F	F	F	F	F	F	F			F		19
18	Redo	Y			Y	Y	Y	Y		Y	Y	Y	Y		Y		9
10	**Q**uit	Q					Q			Q			Q				7
9	**B**old	B	B	B	B	B											5
9	Exit	Q			Q	Q											7
9	**G**o to	G	G	G			G			G							5
9	**I**talic	I	I	I	I	I	I										4
8	Align **J**ustify	J	J		J	J	J								J		3
8	Align **L**eft	L	L		L	L	L										4
8	Align **R**ight	R	R		R	R	R								R		3
8	Center	E	E		E	E	E								E		3
8	New **T**ab	T						T	T		T					T	4
8	**U**nderline	U	U	U	U	U	U										3
7	**H**istory	H						H	H		H						4
7	Source	U						U		U	U					U	3
6	Find Again	G						G		G							4
6	**R**efresh	R							R								5
6	**R**eplace	R										R					5

Table 3 - Part 1: Information on command keys, presented according to the commands

5	**B**ookmarks	B						B		B	B					2
5	**D**eselect	D												D		4
5	Invert	I												I	I	3
5	Replace	H	H	H			H									2
5	Search	E						E	E							3
4	Add bookmark	D						D								3
4	Duplicate	D											D			3
4	Find	G														4
4	Import	I														4
4	Information	I								I						3
4	Hyperlink	K	K	K												2
4	Quick view	Q							Q						Q	2
4	Reload	R						R		R	R					1
4	Search	F												F		3
3	Create	N										N				2
3	Downloads	J						J			J					1
3	Edit	E								E						2
3	Export	E														3
3	Filter	F														3
3	Font	D	D				D									1
3	Group	G														3
3	Hide	H														3
3	Open	L						O								2
3	Repeat	Y	Y	Y												1
3	Size	H														3
2	**M**essage	M								M						1
2	**Number of other commands in 2 programs**		0	0	1	1	0	0	0	0	2	0	1	1	0	1	29
1	**Number of other commands in 1 program**		2	3	1	0	3	2	7	4	4	1	6	6	0	10	

Table 3 - Part 2: Information on command keys, presented according to the commands
Note. Bold font is used to indicate command names associated with international command keys (Paste, Copy, and Undo) and the first mnemonic letters of commands. Grey cells are used to indicate the repeated (in top – down direction) command names.

keys have been included in the analysis to provide a complete overview and confirm that these three commands are not related to any other letters.

Analysing the other 23 letters that have strong relationships with the commands, it has been observed that 19 letters have a mnemonic relationship with the English command names. On the one hand, this supports the localisation of the keys; on the other hand, the table shows that the

commands are strongly related to the letters. Both points are important. Therefore, the localisation should be carried out by means of preserving the same level of stability as in the original version of the software. This can be achieved by localising the command key letters in all programs. The larger the number of programs that use the command, the more difficult it becomes to achieve the goal. If the command is used in only one program, the key can be freely localised. There is also no considerable

Ctrl+	English	German	French	Spanish	Lithuanian	Finnish	Polish
A	Select **A**ll	**A**lles markieren	Sélectionner tout	Seleccionar todo	Pažymėti visus	Valitse kaikki	Zaznacz wszystko
B	**B**old	Fett	Gras	Negrita	Paryškintasis	Lihavointi	Pogrubiony
C	**C**opy	Kopieren	**C**opier	**C**opiar	Kopijuoti	Kopioida	Kopiować
D	**D**eselect	Auswahl aufheben	**D**ésélectionner	Anular selección	Naikinti pasirinkimą	Poista valinta	Anuluj wybór
E	Center	Zentriert	Centre	Centro	Centruoti	Keskittää	Wyśrodkować
F	**F**ind	Suchen	Rechercher	Buscar	Rasti	Etsi	Znajdź
G	**G**o To	Wechseln zu	Atteindre	Ir a	Eiti į	Siirry	Przejdź do
H	**H**istory	Verlauf	**H**istorique	**H**istorial	Retrospektyva	**H**istoria	**H**istoria
I	**I**talic	Kursiv	**I**talique	Cursiva	Pasvirasis	Kursivointi	Kursywa
J	**J**ustify	Im Blocksatz ausrichten	**J**ustifier	**J**ustificar	Abipusė lygiuotė	Tasata molemmatreunat	**J**ustować
K	Hyperlink	Link	Lien hypertexte	Hipervínculo	Saitas	Hyperlinkki	Hiperłącze
L	**L**eft	**L**inks	Gauche	Izquierdo	Kairė	Vasen	**L**ewe
M	**M**essage	Nachricht	**M**essage	**M**ensaje	Pranešimas	Viesti	Wiadomość
N	**N**ew	**N**eu	**N**ouveau	**N**uevo	**N**aujas	Uusi	**N**owy
O	**O**pen	Öffnen	**O**uvrir	Abrir	Atidaryti	Avoin	**O**twórz
P	**P**rint	Drucken	Imprimer	Imprimir	Spausdinti	Tulosta	Drukuj
Q	**Q**uit	Beenden	**Q**uitter	Salir	Baigti	Hiljainen	Zamknij
R	**R**ight	**R**echts	Droit	Derecho	Dešinė	Oikeus	Prawo
S	**S**ave	**S**peichern	Enregistrer	Guardar	Įrašyti	Tallenna	Zapisz
T	New **T**ab	Neue Registerkarte	Nouve longlet	Nueva pestaña	Nauja kortelė	Uusi välilehti	Nowa karta
U	**U**nderline	**U**nterstreichen	Souligné	Subrayado	Pabraukti	Alleviivattu	Podkreślenie
W	Close	Schließen	Fermer	Cerrar	Uždaryti	Sulje	Zamknij
Y	Redo	Wiederholen	Rétablir	Rehacer	Perdaryti	Tehdä uudelleen	Wykonaj ponownie
Number	19	6	9	5	1	1	5
%	83	26	39	22	4	4	22

Table 4: Command key letters in English software and their mnemonics properties in various languages
Note. The command names have been taken from the Microsoft Language Portal (Microsoft Corporation 2010).

difficulty if the command is used in 2 or 3 programs.

Table 4 presents the mnemonics situation for a number of languages from different groups (German, Roman, Baltic, Finno-Ugric, and Slavic) when command key letters were not localised. The table indicates that the situation in all languages is considerably less satisfactory when compared with English (non-mnemonic keys for localised command names are marked in grey background).

3. Recommendations for the Localisation of Shortcut Keys

The results of the analysis of command keys in relation to commands are less fragmented than those of the letters. One command is usually less likely to be related to several letters than one letter being related to several commands. This is obvious because the number of letters available in the alphabet is lesser than the number of commands. On the other hand, the relationship between the command and the letter is initiated with the command, i.e. a letter for a particular command is selected but not vice versa. The results are presented in Table 5.

These commands in Table 5 are presented in the same order as in Table 3, except for the fact that three commands, which have "international" status, are brought to the front of the list and marked with '1' in the row 2. In the other rows of Table 5, factors that have an impact on localisation are marked with '1'. They are the shortcut keys:

1 With letters that possess "international" status,
2 That are recommended to unify (*Keyboard Shortcuts* 2012),
3 With letters that are related to one command only (according to Fig. 1).

From this information, and the information in Table 3, the following recommendations about the localisation of command keys could be presented.

1. Command keys that have international status are not subject to localisation. Their commands have a mnemonic connection to the visual appearance of the letter and are not related to the usage of the command name in some languages.

2. The keys of commands that are not mentioned in Table 5 have to be localised. 119 such commands have been found in the analysed programs. Their keys are either rarely used (in one or two programs out of the 50 programs analysed), or their letters are used in other key combinations that are used more often. For these commands, the letters related to other commands should be used. Such relationships are unavoidable since there are fewer letters than commands. Even the letter *Z*, which is internationally accepted, is used for other commands in the original programs (see Fig. 1). However, it is important that the letter selected during localisation should not conflict with other command keys for the same program. This is a common rule for any shortcut keys (command keys and access keys) that are successfully implemented in software products.

No.	Command	Cut	Paste	Undo	Copy	Select All	Open	Save	New	Print	Close Window	Find	Redo	Quit	Bold	Go to	Italic	Align Justify	Align Left	Align Right	Center	New Tab	Underline	History	Duplicate	Hyperlink	Message
1	**Letter**	X	V	Z	C	A	O	S	N	P	W	F	Y	Q	B	G	I	J	L	R	E	T	U	H	D	K	M
2	**International**	1	1	1																							
3	**Recommended to unify**	1	1	1	1	1	1	1	1	1	1	1		1	1		1						1				
4	**Letter – 1 command**	1	1		1	1	1	1			1																

Table 5: Predominant pairs of letters and commands

3. It is more difficult to present recommendations for the other commands, listed in Table 5. The commands are presented in descending order according to both their usage in programs and in terms of localisation difficulties. If a key is localised, it should be localised in all other programs appropriately. The more programs that use the command, the more difficult it becomes

to use the same letter in all of the programs.

Additionally, the recommendation to unify command keys, i.e. to leave them all unlocalised, or to make them unified in the target locale should be taken into consideration. The attribute in the last row of Table 5 indicates that the letter is related to the same command in all programs, and it becomes the responsibility of the localisers to not reduce the number of the keys that possess the same quality.

4. Evaluating the attributes that are presented in rows 3 and 4 of Table 5 it becomes possible to modify the order of the letters (as well as one of the corresponding commands), presented in the first row of this table. The list of the letters below is presented starting with letters that have higher priority unification:

Keyboard layout	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Albanian		{		Đ		[	]				ł	Ł	§	}			\		đ			@	|			
Czech		{	&	Đ	€	[	]				ł	Ł		}			\		đ			@	|	#		
Danish					€								µ													
Dutch			¢		€								µ					¶	ß					»		«
Estonian					€														Š							Ž
Finnish					€								µ													
French					€																					
German					€								µ				@									
Hungarian	ä	{	&	Đ	Ä	[	]		Í	í	ł	Ł	<	}			\		đ		€	@	|	#		>
Irish	Á				É				Í						Ó						Ú					
Icelandic					€								µ				@									
Italian					€																					
Latvian	Ā		Č		Ē		Ģ		Ī		Ķ	Ļ		Ņ	Õ			Ŗ	Š		Ū					Ž
Lithuanian					€																					
Lithuanian (Standard)					€	“											|						}	%		
Maltese	À				È				Ì						Ò						Ù					
Norwegian					€								µ													
Polish		{		Đ									§	}			\		đ		€	@	¦			
Portuguese					€																					
Romanian		{		Đ							ł	Ł	§	}			\		đ			@	|			
Romanian (Standard)				Đ	€							Ł				§			ß							
Slovak		{	&	Đ	€	[	]				ł	Ł		}		‘	\		đ			@	|	#		>
Slovenian		{			€	[	]				ł	Ł	§	}			\					@	|			
Spanish					€																					
Swedish					€								µ													
Turkish	Æ				€				İ								@		ß							

Table 6: The characters on the A…Z keys that are typed using the third level of keyboard in different languages

XVZ CAOSW NPFQBIU YGJLRETHDKM. Letters are split into four groups according to the '1' marks in Table 5:

1st group: marked with 1 in row 2;

2nd group: marked with 1 in rows 3 and 4;

3rd group: marked with 1 in row 3 only;

4th group: not marked 1 in any row.

4. Special Characters on the Third Level of Keyboard Layouts

According to the international standard ISO/IEC 9995, the third level of the keyboard is used to type characters that are used quite rarely. In all of the European languages that use the Latin script, with the exception of US English, three keyboard levels are used. To type a character, assigned to the third level, the key of that character should be pressed while holding the third level key (*Alt Gr*). In previous keyboards without the third level keys the key could be simulated by the key combination *Ctrl+Alt (Left)*. Such a key combination together with a character could be potentially used for command keys. This causes no difficulties if there are no such characters assigned to the third level of a particular language keyboard. But if a character is assigned to the third level, the action of typing that character will be blocked by the command key combination. Therefore, it is important to find out which keys have third level characters. The results of the analysis of various language keyboard layouts are presented in Table 6.

Table 6 clearly indicates that only three keys (*H, T*, and *Y*) do not have third level characters in all keyboards of the languages analysed. Therefore, the key combination *Ctrl+Alt* will not cause any conflict for these letters if used in the command keys. The third level of all other 23 letters is occupied in at least one language keyboard; therefore, the combination *Ctrl+Alt* should not be used with these letters. It is likely that the fact that the three letters mentioned are not occupied is just a coincidence. Therefore, in general, the pair *Ctrl+Alt* should not be used at all for any keys. If there is at least one key combination of *Ctrl+Alt* and a letter, this should be considered as an internationalisation error. Such combinations will not raise any problems in localised programs if the keyboard of the localisation target language does not have any third level characters on the key marked with that letter.

The keyboards of almost all languages have third level characters on all numeric keys. Therefore, the *Ctrl+Alt* combination used with any numeric character for the command key should also be treated as an internationalisation error. Thus we arrive to more radical solution: suggesting that the replication function from *Ctrl+Alt* to *Alt Gr* be removed from keyboard driver generating tools.

5. Key Combinations Using the Second Level Key

Letter keys in shortcut keys are usually indicated as capital letters, however they are typed as small letters, i.e. without the second level key (e.g., *Shift*). This does not cause any misunderstandings as letters on the keys are also presented as capital letters. In fact, the letters are used as key names but not as letters. Thus, the command keys are not influenced by the "caps lock" state.

Sometimes the second level key is used in command key combinations. In such a case, the second level key does not change the level of the keyboard, and it is included in the key combination in an expressed way, e.g. it is shown as *Ctrl+Shift+A* and explained as: "press control key, shift key, and letter A key", rather than "press control key and the capital letter A".

The second level key is rarely used together with letter keys in command key combinations and does not form a strong relationship as discussed above; therefore, such command keys may be localised freely. Sometimes, the second level key is used in the localised version of command keys so that the localised key does not cause any conflict with other, non localised keys. An example of such a case would be the usage of the combination *Strg+Umschalt+F (Ctrl+Shift+ F)* in German localised software. The combination is applied to invoke the command that changes the font of the selected text to bold (*Fet* in German). Such a key is selected in order to retain the letter *F* in a non-localised key combination for *Search* command *Strg+F* (*Ctrl+F*). It is less comfortable to press two keys (*Ctrl+Shift*) instead of one but it is likely that it is viewed as being easier than using a non-localised key, otherwise localisation would have been in vain.

Numeric row keys are also named by numbers, regardless of which level of the keyboard is used to type them. In the English language keyboard numbers are presented on the first level. The same is applicable for keyboards in the majority of other

languages. Therefore, they should not be localised because the number mnemonics, if used, are similar or the same in many languages. For example, *Ctrl+5* can mean a browser command *Open Tab 5*. However in languages where numbers are presented on the second level of the keyboard (e.g. French, Lithuanian), a localiser will need to modify the program so that the key combination *Ctrl+n* would have the meaning of pressing a control key and the key of number *n* (i.e. so that the second level key does not have to be pressed).

6. Command Key Characters in Keyboard Drivers

In keyboard drivers, characters that are used in combinations of command keys are defined separately from the characters that are typed by pressing keys to produce a regular text. Therefore, a keyboard driver can be developed to distinguish the layout of command keys and the keyboard. For example, the QWERTZ keyboard is used in Germany. In this layout of the keyboard, the letter *Z* is on the same key as the letter *Y* in the layout of the QWERTY keyboard. Therefore exhausting the possibilities of the development of the keyboard driver discussed above, the QWERTZ keyboard can be developed for Germany as follows: The command *Undo*, marked by *Ctrl+Z* could be called by pressing either the letter *Z*, to conform to the German keyboard, or the letter *Y*, to conform to the position of the letter Z in the English keyboard. Moreover, any other letter key that corresponds to the position of the letter *Z* could be used as well. Let us look at how this is carried out in practice.

During our research, the layouts of the German QWERTZ and the French AZERTY keyboards were tested and it was noted that neither of them distinguish between the position of the keys that are used for command keys, and those that are used to type regular text. This decision is natural. The "unnatural" layout (as in the example above) is required in special cases, for example, with languages that use a non-Latin script but apply Latin letters in command keys when the keyboard is phonetic and is used in other language environments.

7. Conclusions

Our investigation shows that the bindings of the command keys to letters in original programs are rather stable, i.e. the command is related to the same letter in all programs (with some rare exceptions). It is advisable to maintain such a positive feature in localised programs, implementing a coordinated adjustment of letters in all localised programs for a particular language.

One letter is usually related to several commands since there are more commands than letters in the alphabet. However, in general there are dominant bindings of letter and command. According to the findings of our analysis of 50 frequently used programs, a list of dominant command-letter pairs has been developed. If a command letter, included in this list, is localised, the coordination of its adjustment in all other localised software is more important and more difficult in comparison to the localisation of other letters.

According to localisation requirements and possibilities the command keys may be categorized into three groups:

1) Letters that do not need to be localised;
2) Group of letters to be used on the basis of national level agreements (23 commands make up dominant pairs of command letters);
3) A group of letters that have to be used according to local agreements (119 commands that are not included in the list of dominant commands).

It has been observed that almost every character key, on keyboards based on the Latin alphabet, is used to type third level characters. Since the key combination *Ctrl+Alt (left)* simulates the third level key (*Alt Gr*), the usage of this combination for command keys must be considered as an internationalisation defect. This defect would lead to a block on typing characters that are assigned to the third level of the keyboard.

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